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The Calder Plan.

THIS is essentially an age of social reconstruction and it must naturally abound in social speculations. The unprecedent progress of physical sciences and the application of the scientific discoveries and inventions to the industrial processes induced a general confidence in the public mind that the line of human development was definitely set in the direction of reason. The faith of the old generation that the betterment of man depended upon his technical advance was frustrated because society as a whole was not organised to receive the benefits of their mechanical progress. Hopes are entertained that, if the social problems are handled in a scientific way, the disharmonies of the world may be assuaged, and a better order of social affairs may be established. For over a decade Sir Richard Gregory and others have been emphasising on the recognition of a change of scientific interest from the physical and biological to the sociological, and as a result of this campaign, the British Association for the Advancement of Science in 1932 was led by Professor Miles Walker to pass a resolution offering its services in the solution of the economic and social problems. This eminently friendly attitude of science towards social environment has now become an article of public faith among scientists, who realise the importance of the relationship between science and society, considered historically in all its continually changing aspects.

The American Association for the Advancement of Science, at its recent session held in Indianapolis, passed a resolution based on the principles of what is called "The Calder Plan". This Plan insists upon a "declaration of the independence of Science"—a *Magna Charta* of Science. The principal features of this Plan are set forth by Richie Calder himself in an illuminating article published in a recent issue of the *Science Forum*.[1] The fundamental idea underlying this Plan is that Science should enjoy absolute freedom in the organisation of research and in the exchange of ideas,—"a free trade in brains," being the badge of the scientific tribe. The implication of scientific discoveries and inventions is that they should

[1] *The Science Forum*, June 1938, 3, 7–11.

be harnessed for the common good of mankind, and for the purpose of prosecuting scientific researches, scientific workers should be left untrammelled to pursue their studies in an atmosphere of peace. It is a portentous fallacy that scientific knowledge could be treated as an exclusive national asset, its blessings are universal. These facts must form the general creed of scientists who ought to own allegiance to no other doctrine.

The British Association for the Advancement of Science which has been keenly alive to the consequences of the impact of Science on a greatly exasperated world, has been considering for a long time the necessity of shifting its alignment to meet the demands of the changing conditions in the social and economic systems. At the Blackpool session and at subsequent meetings the Association recognised the need of bringing into existence an organisation for enquiring in an objective spirit the social relations of science. In view of the common ideals animating the spirit and outlook of the two Associations, Calder proposes in the first instance the formation of "an English-speaking Consortium" which should ultimately develop into a democratic World Association, devoted to the consideration and solution of "international social problems, with the safeguarding of the interests and independence of scientists". The membership of this somewhat fat Association is to be thrown open to all scientists subscribing to the *Magna Charta* of the scientific democracy, who, accepting the responsibility of their position, should act as a link between the specialist in their own particular branch of knowledge, and those who are responsible for government, so that the world of scientific discoveries might do the greatest good to mankind. It is doubtful, however, whether the scientists in the totalitarian states will recognise, the democratic principles of science, and whether the proposed organisation will include the Nazi and Fascist scientific men.

On account of the rather unwieldy dimensions of this Association which naturally would be unable to attend to the routine day-to-day work, Calder has devised an auxiliary organisation which would receive knowledge, initiate enquiries and researches and which would co-operate with the other social and political institutions of the world. This auxiliary body is to act as the "brain-trust" for the World Association and on the analogy of the technical committees of the League of Nations, this subsidiary trustee "would be adviser of all nations, but as an association, subject to none". Calder's idea of a "Science League of Nations" which is only another name of his World Association has been summarised by the *New York Times* in these words: "Mr. Calder has not exaggerated. To save science, his World Association is needed, an organisation which shall indicate how the objective attitude of the laboratory may be applied in governing a people, in breaking down prejudices, in preventing war, in solving problems that mean progress, not in one country alone, but the world over." The labours of Calder are devoted to "bring to a tortured world, perplexed and frustrated by the ineffectiveness, by the animosities, prejudices and chauvinism of the world's statesmen, the objectivity, the disinterested enquiries and the laboratory thoroughness of science and you may give the world peace and rationalism; help to dispense as well as to provide the bounty of science, and achieve economic security and the fullness and fruitfulness of the Age of Plenty for the peoples of all nations".

These sentiments are admirable and the proposed World Association is heroic. Both are great ideals which, we fear, are still laid up in Heaven.

The British Association has proposed a less ambitious scheme, based on the series of articles in *Nature* on the "rapidly growing awakenness of the importance of those complex problems confronting our community, due primarily to the astonishing rate of advance of scientific knowledge during the last generation" and with the object of obtaining representative opinions upon the subject of social repercussions of science, a symposium was recently organised. In the supplement to *Nature*[2] is published a series of letters contributed by about forty leading scientists and publicists whose comments emphasise the necessity of going deeper into the social relations of science and indicate in general outline the principal activities to be undertaken and the methods of achieving the underlying objects. It is obvious that as the sciences become specialised, they tend to develop a spirit of

[2] *Nature*, April 23, 1938, 141, 3573, 723–42.

exclusiveness and pretentious airs are disastrous to sciences as they must be to society, whose problems are created by science. With a view, therefore, to bring about a closer relationship between scientific and social workers, the British Association is proposing to establish a new organisation, a Society for the Study of the Social Relations of Science. At the forthcoming meeting of the British Association at Cambridge, the proposal for the formation of a society of this nature is expected to be discussed, and we envisage that a definte scheme will be put forward for organising the scientific workers into a comprehensive body who would devise a mechanism for the application of scientific knowledge in promoting social well-being and betterment. Time is not far off for India to establish international affinities with these movements which, we hope, will point the way for a better and a happier world state.

The Fisheries of India.

By J. Travis Jenkins, D.Sc., Ph.D.,

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(*Formerly Fishery Adviser, Government of Bengal.*)

IT is now thirty years since the late Sir K. G. Gupta submitted to the Government of Bengal his report on the fisheries of the province. In this report he asked for a systematic survey of each district under expert supervision and on definite lines " and the results are sure to be valuable and far-reaching ".

Sir K. G. Gupta's report may be read with advantage even to-day, since he draws attention to many problems affecting the fisheries of the province which still require investigation and elucidation. In 1915 the first Madras Fishery Bulletin was published by Sir F. A. Nicholson. It dealt with papers from 1899 relating chiefly to the development of the Madras Fisheries Bureau. In 1937 Dr. Sundara Raj published the administration report for the year 1935–36. Between those two dates the Madras Fisheries Bureau has published a long list of papers and reports dealing with the fisheries of that province.

In 1910 Mr. Kiran Chandra De published at Shillong, a valuable and interesting report on the fisheries of Eastern Bengal and Assam, and there are other provincial reports which it is not essential to specify more exactly.

Now while these various reports are very interesting and some are extremely valuable, there is one obvious defect and that is the lack of co-ordination due to the fact that the fisheries are controlled by the Provincial and not the Central Government.

On the first of July, 1916, the Zoological Survey of India was inaugurated so that it came of age last July, when its twenty-first birthday was attained. Apart from maintaining the zoological collections of the Indian Empire in the Indian Museum at Calcutta, one of the chief tasks of the Survey was to obtain the fullest possible information about the systematic and geographical zoology of the Indian Empire and to place this information at the disposal of inquirers.

Outside scientific circles it is not widely known that the Secretary of State for India in Council publishes volumes dealing with the Fauna of British India including Ceylon and Burma. If we look up the volumes dealing with fish we find that they were published as long ago as 1889, the author being the late Francis Day; who also published reports on the Fresh-water Fish and Fisheries of India and Burma (1873), and the Sea Fisheries.

It is interesting to note that a second edition of the volumes on Fish in the Fauna of India is in the course of preparation by Rai Bahadur Dr. Sunder Lal Hora. This edition, which will have to be entirely rewritten to be effective, will extend to at least five volumes. It will be seen, therefore, that there are several independent bodies interested in the Fish and Fisheries of India, namely the Zoological Survey of India, the Provincial Governments and the Secretary of State. Now, although much information has already been obtained as a reference to the above-mentioned reports will show, it is obvious that very much more remains to be done and that there is urgent need for further investigations and particularly for co-ordination.

How can this best be secured ?

Nearly every civilised country in Europe, America and Africa with important fishery interests has a central fishery bureau or department either directly working as a

government department or directly controlled by such a branch.

India with its vast rivers, estuaries, tanks and ponds on the one hand, and its enormous coast line and marine fish on the other hand, with enormous potentialities for development, simply cannot afford to drop behind. The development of markets for fresh fish, with the allied problems of transport and ice, the preservation of fish whether by canning, smoking or other process, the investigation of the fish-oils and other bye-products such as fish-meal and manure, all offer problems requiring urgent investigation and offering results of immediate practical value.

This problem was considered in the year 1938 at a combined meeting of the Indian Science Congress Association and the British Association for the Advancement of Science held in Calcutta, when the sections of Zoology, Medical Research, Veterinary Research, Entomology and Agriculture held a joint session. Following this the Zoology Section passed the following resolution :—

"This meeting of the Zoology Section of the *Indian Science Congress Association* in session at Calcutta, urges upon the Government of India the necessity and importance of constituting an all India Department of Fisheries for the development of the fishery resources of Indian waters on scientific lines. It is of opinion that the commercial development of the fisheries of India should be accompanied by the scientific investigation of fishery problems by means of a carefully planned programme of co-ordinated scientific investigation of fishery problems, which can most easily be controlled by one central authority for All-India, leaving to the separate Provincial Governments the task of administration of the fishery laws and regulations.

It is further of opinion, that, unless development of the fishery resources of Indian waters is carried out with due regard to the scientific principles which form the basis of successful fishery developments, there will be grave danger of irreparable damage to the fisheries concerned."

As an example of what can be done to assist the fisheries by a properly constituted central bureau subsidised by the Government, let us take Japan.

Japan now produces annually half-a-million cases of canned crabs, worth over two million pounds sterling. In 1937 Great Britian imported 39,220 cwts. of canned "crabs" from Japan worth £333,773. This so-called crab is not a crab at all but a species known as *Paralithodes camtschatica* and is not to be compared in quality or flavour with the prawns of the Bay of Bengal and the Gangetic Delta.

Great technical difficulties were met with in the first attempts to can these crabs and it is in a very large degree due to government subsidized research that this great Japanese fishing industry has been built up in comparatively few years.

Last year Great Britain imported canned Norwegian sprats to the value of £ 263,309.

In the Bay of Bengal there are enormous shoals of fish resembling the sardine and far superior in flavour to the sprat. The Kokile (*Clupea kunzei*) of the Telugu fishermen is a case in kind. In some countries there is an enormous demand for salted mackerel. Here again the Bay of Bengal can supply the demand. The Kanagurta (*Scomber microlepidotus*) is an excellently-flavoured fish.

The home market for fish is quite inadequately developed. There is scope for much research into the best methods of conveying fish, either fresh or lightly cured, to the home markets.

Many people have an idea that Indian waters are devoid of fish of good flavour and high nutritious value. There can be no greater mistake. There are Indian fish which compare favourably with the best in the world. There are no better fish anywhere than the Hilsa, Bhekti, Topsi and the "Bombay Duck". The crabs, shrimps and prawns are unsurpassed. There can be no doubt whatever that the material is there. What is wanted is proper investigation so that these immense resources may become available for the benefit of the community. There is only one way, in India as in other lands, and that is, the scientific investigation of fish and fish products on the lines so successfully established in the United States of America, Japan and most European countries.

This was fully recognised by the experts who attended the Science Congress in Calcutta last January. Prof. Tattersall, Lt.-Col. Sewell, Prof. de Beaufort and others supported the resolution outlined above.

It is to be hoped that the Government of India will establish a Central Bureau of Fisheries at an early date so that the immense wealth of Indian waters at present lying dormant and undeveloped may be developed rationally. India is fortunate today in having available men like Dr. Hora, Dr. Prashad and Dr. Sundara Raj with considerable experience in fish and fishery matters who could assist in the formation and development of any organisation formed to develop the fisheries of the country.

The Control of the Blight Disease of Gram by Resistant Types.

By Jai Chand Luthra, I.A.S., B.S., Abdus Sattar, Ph.D., and Kishan Singh Bedi, M.Sc. (Ag.).

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IN the Punjab, gram or chick-pea (*Cicer arietinum*) occupies the largest area next to wheat. Including Indian States it has an acreage of about 5½ millions. Its greatest value lies in the fact that it is almost the only Rabi crop that can be successfully grown in the Vast Barani (rain-fed) tracts of the province and therefore carries great economic importance for the bulk of the farming population of these areas.

For decades of years this valuable crop has been suffering severely from the attack of the blight disease caused by the fungus *Ascochyta rabiei* (Pass) Lab. Often it has broken out in epidemic form particularly in the northern districts of Attock, Rawalpindi and Jhelum bringing about total destruction of the crop. For the last two successive years, the gram crop has been altogether wiped out. Every plant was killed at the flowering and fruiting stage and not a single grain was recovered from diseased fields. The investigation of this serious disease was entrusted to the authors in 1932 and the work so far done on the study of the life-history of the causal fungus and measures of its control have been published.[1, 2]

Symptoms.—The most marked symptoms of the disease are :—

Dark brown spots appear on stem, leaflets and pods. These spots form elongated lesions on stem and petiole. But on leaflets and pods they are circular and concentrically arranged. Minute black dots are produced on the lesions. These are the spore bodies (Pycnidia). The parts of the plant above the lesions collapse and dry up. Terminal portions are invariably first affected. The disease usually appears in February and if there are showers of rain accompanied by wind, it spreads very rapidly by dissemination of spores and continues up to April. Within a fortnight the disease has been observed to overtake many fields and kill the crop.

The disease has been found to be carried over from one season to the other by—

(1) infected seed ;

(2) by diseased debris left in fields after the crop is harvested.

The methods of control recommended are : (1) use of clean disease-free seed, (2) clearing of the fields of all diseased material. But unless these methods are adopted collectively all over the gram growing areas and executed to perfection, the disease cannot be checked. The process of cleaning of fields and threshing floors has to be accomplished with such thoroughness that not the least of infected material escapes collection and destruction. Both the methods have to go together. In practice, however, the farmers have not shown much anxiety and initiative to employ the methods to the desired extent. Under such circumstances, the alternative course has been to discover types resistant to the disease.

For this purpose, 187 types of gram obtained from America and Europe and several parts of India, were grown and tested by artificial inoculation with cultures of the causal fungus and diseased material as follows :—

(1) By spraying pycnospores in suspension in water. The spores were taken from pure culture of the fungus *Ascochyta rabiei* grown in oat-meal agar for three weeks. The plants were kept covered by *Sarkanda* for about a week to provide moist conditions for the development of the disease. The inoculations were done in February each year and in order to provide a heavy dose of infection the inoculations were repeated in March again.

(2) By spreading diseased gram plant debris over the plants after having first ascertained that the stalks of the debris were bearing a large number of pycnidia of *Ascochyta rabiei* and more than 70 per cent. of the spore contained in them were viable. The plants inoculated by this method were not covered with *Sarkanda*. Both the methods gave equally good results.

All the Indian types and most of the foreign types caught infection and were killed. Only three types among others supplied by the Bureau of Plant Industry, Washington, U.S.A., were observed to withstand inoculation and proved resistant fully or partially. These are the following :—

(1) *Pois chiches* No. 281 – Very resistant.
(2) *Pois chiches* No. 199 – Very resistant.
(3) *Pois chiches* No. 180 – Fairly resistant.
(4) *Pois chiches* No. 4F32 – Very resistant.

[1] Luthra, J. C., and Bedi, K. S., *Ind. J. Agric. Sci.*, October 1932, 2, Part V.

[2] Luthra, J. C., Sattar, A., and Bedi, K. S., *Agr. and Live-Stock in India*, September 1925, 5, Part V.

These types appear to have been imported into Washington from France.

These types gave distinct indications of resistance from the first year of trial in 1933 and single plant selections were made. The isolation of vigorous plants and those well-adapted to the climate was continued every year.

About 2 oz. seed of each type was all that was got to begin with. Inoculation tests and pedigree culture of selected plants have been carried on for the last five years. The three foreign varieties 4F32, 199 and 281 remained outstanding regarding power of resistance. Slight infection occurred under severe inoculation tests, but no damage was caused. Some lesions were formed but no pycnidia developed. It appears that infection was not followed by penetration of the fungus and the tissues were not injured. Though these types cannot be classed as immune, yet their power of resistance is strong enough to protect the crop from the disease. Type 281 is most resistant, 4F32 comes next and 199 is third in this respect. The seeds of these types have distinctive morphological characters. Type 281 has black colour, slightly rough surface, large size and irregular shape. Weight of the seed is 2¼ times the usual type.

Type 199 has dull white colour, smooth surface and medium size. Seed is about 1½ times in weight of the grain of a normal type. It resembles the well-known Punjab small Kabuli type.

4F32 has yellow colour, rough surface like Punjab type 7, but has prominently larger size and is about 1½ times in weight. This type being similar to a local gram and having very little of foreign features, is readily acceptable to the farmers. Of the three types, this was selected as most suitable for introduction into the husbandry of the Province as a new production to replace the local seed and combat the blight disease. It was, therefore, decided to focus attention on it and test it for yield. In 1936 sufficient seed became available for this purpose. It was sown in eight replications of 1/32 acre each. As the seed of 4F32 weighs 1·5 times that of Punjab type 7, the standard seed rate of 16 seers was increased to 24 seers in order to get a comparable stand and normal number of plants per acre. Good and uniform germination was obtained and the average yield was 14 maunds 13 seers per acre. This out-turn compares very favourably with the general yield got from local types. Similar yield trials were carried out in 1937–38 season and out-turn of the order of 14–16 maunds per acre was obtained. The type has proved satisfactory as regards yield and thus fulfils one of the crucial tests usually applied to determine the value of a newly evolved strain from the view-point of the farmer, *i.e.*, adequate return per acre. Besides, the most significant and priceless asset of the type is its ability to withstand the destructive blight disease on account of the prevalence of which the cultivation of gram in the north Punjab has become problematical. The poor farmer of this tract is threatened with loss of the only means of existence. Gram is the life and soul of the people and blight has been a calamitous visitant and a great menace for long to this part of the country. The evolution of the resistant strain is a precious boon to them and the surrounding area including the North West Frontier Province where also the disease has made a deep foothold. Sixty maunds of seed of this valuable type 4F32 has been raised this year. For convenience of reference it has been given the new name of type F.8. A comparison of resistant type 8 and Punjab type 7 after severe inoculation is shown in Fig. 1. Pb. type is almost completely killed while type F.8 is flourishing.

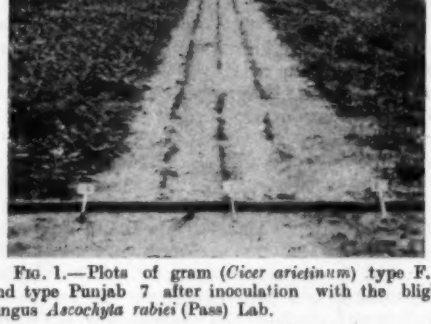

FIG. 1.—Plots of gram (*Cicer arietinum*) type F. 8 and type Punjab 7 after inoculation with the blight fungus *Ascochyta rabiei* (Pass) Lab.

Arrangements will be made next season to further multiply this seed by growing it on Government farms under strict supervision. One hundred acres will be sown with it in October 1938. It is expected that in 1940 about 25,000 maunds of seed of this type will be in hand for supply to farmers and a considerable part of the blight-stricken area will be relieved of the virulent pest.

This newly evolved type is evidently a great contribution to disease-resistant

strains of farm crops evolved in India and is a sure means of overcoming the ravages of the serious blight disease of gram. Experience has convinced the authors that in the matter of control of diseases of staple crops grown on extensive areas, neither spraying nor clean-up methods, however effective they may be, are of any avail in India as it is impossible to get farmers to carry them out to perfection. Ultimately the solution lies in the direction of finding out resistant types as is being done in Australia, America and other countries to control Flag Smut, Bunt, Wilt, etc.

OBITUARY.

Dr. Alfred Barton Rendle, D.Sc., F.R.S., F.L.S. (1865–1938).

DR. ALFRED BARTON RENDLE, D.Sc., F.R.S., F.L.S., who died at his home at Leatherhead, Surrey, on January 11th at the age of 72, was for many years Keeper of the Department of Botany at the British Museum of Natural History.

He was born in London on January 19th, 1865 and educated at St. Olave's Grammar School, Southwark, and St. John's College, Cambridge.

In 1888 he was appointed Assistant in the Botanical Department of the British Museum. In the same year he was elected a member of the Linnean Society of London. In 1894 he became Lecturer in Botany at the Birkbeck College where he taught for two or three evenings in the week until 1906. In 1906 he was appointed Keeper of the Department of Botany and his work and interests increased and broadened. He became connected with the Royal Horticultural Society, the Quekett Microscopical Club, the British Association for the Advancement of Science, and after the International Botanical Congress in Vienna in 1905 he took an active part in deliberations concerned with revision of rules for Botanical Nomenclature. In 1909 he was elected a Fellow of the Royal Society and later served as President of the Linnean Society. From 1929–1931 he served on the Council of the Royal Society. He became Professor of Botany to the Royal Horticultural Society and served on several of their scientific and administrative committees. This Society bestowed medals on him in 1917 and 1929 in recognition of his achievements and services.

Dr. Rendle wrote numerous papers on botanical subjects and a text-book,—the *Classification of Flowering Plants*. He was botanical editor of the eleventh edition of the *Encyclopædia Britannica* and from 1924 he edited the *Journal of Botany*. He prepared new editions of the *Bibliographical Index of British and Irish Botanists* and Bentham's *British Flora*. He also collaborated with William Fawcett (died 1926) in preparing a *Flora of Jamaica* on the sixth volume of which he was still working. He was keenly interested in the protection and preservation of the wild flowers of the British Isles and presided at meetings of Societies of Naturalists in different parts of England. He continued to be occupied with much of this work after his retirement from the post of Keeper in 1930.

He took part in many meetings of the British Association for the Advancement of Science, and in 1916 was President of the Botanical Section. With this Society he visited Australia, Canada and South Africa. A visit to Bermuda and Jamaica in 1933 stimulated his interest in the flora of these islands. He had never visted India, apart from a day or so in Ceylon, and as a representative of the British Association he was keenly anticipating taking part in the twenty-fifth (Silver Jubilee) session of the Indian Science Congress Association this January. This venture was tragically cut short by the illness which proved fatal. He contracted a chill on the boat on his way to India. This aggravated some latent trouble and after a week in hospital in Bombay he was advised to return immediately to England. He reached his home on January 8th and died peacefully there three days later.

The writer had the opportunity of working with Dr. Rendle at the British Museum (Natural History), London, a little before he left for India when he expressed much enthusiasm for his prospective visit to India. Dr. Rendle's keen interest in the writer's works and his valuable suggestions in the researches on Systematic Botany will be of considerable use. Dr. Rendle's courteous manners, his pleasant dealings and his willing co-operation in scientific works will be remembered by all who came in touch with him. We deplore his death and offer our most sincere sympathy for the bereaved family.

K. P. Biswas.

LETTERS TO THE EDITOR.

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Magnetic Anisotropy of Egg Shells.

The author has determined the magnetic anisotropy of several specimens of egg shells by the methods described in his earlier papers on the magnetic anisotropy of natural substances.[1] Egg shell according to Stewart[2] essentially consists of: (1) a thin outer layer made of protein, (2) middle layer (comprising 80% of the thickness of the shell) of calcite crystals with protein in the form of interlacing fibres and a small quantity of crystalline calcium phosphate and (3) small knob-like formations of calcite and calcium phosphate constituting the inner "mamillary" layer. Langworthy[3] gives the percentage composition of the shells as follows:

	Organic matter	Calcite	Magnesium carbonate	Calcium phosphate
Hen's egg ..	4·2	93·7	1·3	0·8
Duck's egg ..	4·3	94·4	0·5	0·8

Only the middle layer consisting almost entirely of calcite was taken up for examination. The specimens were cleaned with very dilute HCl followed by distilled water and alcohol. The results representing the mean of several determinations carried out with four specimens of hen's egg and two of duck's are given in the table below. The specific anisotropy refers to the difference in the susceptibilities parallel and perpendicular to the shell surface in the case of egg shells, and parallel and perpendicular to the optic axis in the case of calcite. The mean susceptibilities were measured by means of the Curie torsion balance.

It is seen that while the susceptibilites of the shells are almost the same as that of calcite, the values of the magnetic anisotropy are found to be much lower. These results are significant in the light of the optical examination of egg shells under the polarising microscope.[4] It has been found that calcite is present in the form of columnar prisms in the middle layer, and examination under convergent polarised light of a tangential section of the shell has revealed that the optic axes of the prisms are inclined to the shell surface. Further, with parallel polarised light it has been found that the extinction directions for the different prisms are different, indicating a random orientation *in azimuth* of the optic axes of the prisms relative to the shell surface. The magnetic measurements fit in very well with these findings. Correlation of the magnetic anisotropy of the shells with that of calcite shows that the lower value of the anisotropy of the shells can be satisfactorily explained as being

TABLE.

Units—c.g.s. E.M.

Specimen	Specific Magnetic anisotropy $\chi_{\parallel}' - \chi_{\perp}' \times 10^8$	Mean susceptibility $\times -10^6$	Remarks
Hen's egg ..	1·2 (1·0 — 1·4)	0·35	The anisotropy in the plane of the shells was practically negligible.
Duck's egg ..	1·6 (1·4 — 1·9)	0·36	
Calcite ..	3·45	0·38	A clear specimen of Iceland spar.

due to the inclined orientation of the optic axes of the calcite prisms and the random orientation of these axes in azimuth relative to the shell surface. The latter also accounts for the absence of anisotropy in the plane of the shells. An interesting feature of the results is that the anisotropy of hen's egg is definitely lower than that of duck's egg. This would indicate that the calcite crystals in the latter have their optic axes more nearly normal to the shell surface than in the former.

My thanks are due to Prof. Sir C. V. Raman for suggesting this line of work.

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Indian Institute of Science,
Bangalore,
August 8, 1938.

[1] P. Nilakantan, *Proc. Ind. Acad. Sci.*, 1935, **2**, 621; 1938, **6**, 38.
[2] Stewart, *Poultry Sci.*, 1935, **14**, 24.
[3] Langworthy, *U. S. Dept. Agri.*, 1901, *Farm. Bul.*, 128.
[4] W. J. Schmidt, *Die Bausteine des Tierkorpers im Polarisiertem Lichte*, 1924, Bonn.

Dielectric Strength of Lacs of Known Origin.

SHELLAC varnishes are extensively employed for the insulation of electrical machinery but no systematic work on the dielectric strength of such varnishes prepared from different varieties of lac has so far been carried out. Verman[1] has drawn pointed attention to this in his paper on the dielectric properties of lac. Poole[2] measured the dielectric strength of films from alcoholic solution of shellac and solid castings, and obtained discordant results. Mackay,[3] and Flemming and Steel,[4] also measured the breakdown voltages of shellac castings and films but details are lacking regarding the percentage of the lac samples and conditions under which the tests were carried out. Similarly, it is stated that hard lac resin possesses enhanced electrical properties[5] but no experimental data are available.

We have carried out experiments with a view to ascertaining the electrical properties of lac from different hosts and those of the hard lac resins prepared from them by hot extraction with dilute soda and fractional precipitation from soda solution.[6] The results will be helpful in choosing the right type of lac to be used in the manufacture of insulating varnishes and indicate the best method of preparing hard lac resin possessing increased dielectric strength and moisture resistance.

The object of the electrical breakdown tests was not so much to determine the absolute value of the dielectric strength as to get comparative data on the different specimens of varnishes. From the data so obtained, the best type of lac for further investigation has been picked out.

The dielectric strength tests were carried out under the following three different conditions.

(1) On varnish films dried at 27° C. for 48 hours in an atmosphere of about 75 per cent. humidity.

(2) On varnish films prepared as in (1) and subsequently baked for half an hour in an oven at 90° C.

(3) On varnish films prepared as in (1) but subsequently exposed for 72 hours to an atmosphere of about 95 per cent. humidity at 27° C.

The films were prepared by dipping sheets of tissue paper twice in the varnish in a manner similar to that described in Appendix I of B. S. S., No. 119–1930. The brass test electrodes were each 1½" in diameter with rounded edges. The weight of the top electrode was approximately 1 lb. The bottom electrode was maintained at earth potential and the voltage between them was increased at a uniform rate until the film punctured. The maximum reading of a voltmeter, connected to the tertiary winding of the testing transformer, was noted at each breakdown. The primary of the transformer was supplied from a 25 cycle source of nearly sinusoidal wave form. Each film was punctured at six different points and the average value noted. The thickness of the film was measured close to the points of puncture by a micrometer and the average taken in reckoning the voltage per mil. The average thickness of the films tested was about 3 mils. The results have been tabulated as shown below.

Note.—All the lac samples were dissolved in 95 per cent. alcohol to give solutions of sp. gr. 0·884 at 27° C.

All the tests were carried out with the electrodes at room temperature.

The results indicate that Jalari lac has a higher dielectric strength than sagade lac. Another interesting point which emerges from this investigation is that seed lac on being dissolved in soda and precipitated acquires a higher value of breakdown voltage. It is surprising that tests after drying at 27° C. give a lower value for the hard lac resins than the original lac but the values increase enormously on heating the specimens at 90° C. for ½ hour. There are three possible reasons to explain such a behaviour.

(1) The films may be freed from water and/or some other conducting liquid locked up therein.

(2) Heating may induce an alteration in the physical state of the film.

TABLE I.

No.	Material	Solid content in 100 c.c. alcoholic solution	Acid value	Breakdown voltage in volts per mil.		
				After drying at 27° C. for 48 hours	After baking at 90° C. for ½ hour	After exposure to 95% humidity for 72 hrs.
1	Sagade seed lac (*Schleichera Trijuga*)	24·36	79·0	1420	1200	600
2	Whole lac dissolved in soda, filtered and precipitated ..	27·26	85·5	1200	1640	570
3	Hard lac resin by fractional dissolution in soda	25·66	83·9	1000	1450	390
4	Hard lac resin by fractional precipitation	23·44	66·5	1190	1750	455
5	Soft lac resin from (4) ..	25·26	84·2	1100	1850	410
1	Jalari seed lac (*Shorea Talura*)—					
	Sample (1) Old	23·80	87·2	1320	1320	580
	,, (2) Fresh	23·90	81·5	1410	1840	620
*2	Whole lac dissolved in soda, filtered and precipitated ..	24·82	88·8	1450	2000	460
*3	Hard lac resin by fractional dissolution in soda	24·36	68·6	1160	1940	400
*4	Hard lac resin by fractional precipitation	23·54	58·6	1120	1910	400

* Prepared from Sample 2 of Jalari lac.

(3) Intramolecular change through polymerisation and condensation of the lac may take place.

We wish to thank Professors K. Aston and K. Sreenivasan for their keen interest and encouragement.

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[1] London Shellac Research Bureau, *Technical Paper* 1936, No. 7, 14.
[2] *Phil. Mag.*, 1921, **42**, 488.
[3] *Can. Chem. & Met.*, 1931, **15**, 215.
[4] *World Power*, 1924, **1**, 140 and 234.
[5] *J.S.C.I.*, 1935, **54**, 86–88 T.
[6] *Chem. and Ind.*, 1938, **57**, 37.

Choline Esterase in Cobra Venom.

The venom of the Indian Cobra (*Naia Naia Vel tripudians*) is a substance of very complicated composition and possesses a remarkable pharmacological activity. A large amount of literature has collected on the subject and many investigators have attempted to explain the cause or the causes which are responsible for the peculiar toxic manifestations produced by the venom. Most of the investigations reported in the literature are centred around the question of the identification and separation of the various constituents, to each of which can be attributed a particular toxic property. Earlier workers like Calmitte[1] believed that the protein fraction (toxalbuminoids) was the active constituent in the venom but later experiments tended to show that certain principles of a non-protein nature might also be involved. Faust[2] reported the isolation of a non-nitrogenous, non-glucosidal principle from the cobra venom (ophiotoxin) which was very closely related in its physical, chemical and pharmacological characters to the saponins. This principle produced all the effects of whole snake venom, except agglutination. That the enzymes present in the venom might have some part to play in bringing about the toxic manifestations of venom poisoning was first brought out by Mathews[3] who showed that the destruction of fibrinogen by the protease present in the *crotalus* (*crotalus adamenteus*) venom was the chief cause of the failure of the blood to clot in *crotalus* poisoning. This finding was later confirmed by Billing.[4] These observations naturally drew the attention of a number of workers (Ganguly,[5] Ghosh *et al*[6]) to the study of the nature and physical and biochemical characteristics of the various enzymes or enzyme complexes present in the cobra venom. Recently, Iyengar, Sehra and Mukerji[7] investigated in detail the nature of the protease in the cobra venom and attempted to explain the biochemical significance of the presence of this enzyme with special reference to the use of the venom in therapeutics. Roy and Chopra[8] studied the comparative biochemical characteristics of the cobra and Russell's viper venom with a view to identify, if possible, the constituents of the venom primarily responsible for the poisoning symptoms associated with snake bites.

The action of the cobra venom in experimental animals was investigated by Chopra and Iswariah.[9] It was shown that the main action of this venom in lethal and sub-lethal doses is on the respiratory system, the effect being one of initial stimulation and final paralysis. The respiratory centre is probably primarily involved but the motor end-plates in the diaphragm and other respiratory muscles are also affected almost simultaneously. There is considerable divergence of opinion with regard to the exact mechanism involved in bringing about the respiratory paralysis. Chopra and Iswariah (*loc. cit.*) produced evidence to indicate that the paralysis is chiefly central in origin. Cushny and Yagi,[10] Houssay[11] and Kellaway and Holden,[12] on the other hand, thought that the seat of motor paralysis was peripheral resembling very closely 'curare' action. Of late, evidence has been advanced that most, if not all, motor nerves on stimulation liberate acetylcholine at their ends and that this substance (and not the nerve itself) carries the impulse across the synapse to the end-organs. It has also been shown that this liberated acetylcholine is quickly destroyed in the blood due to the presence of a specific choline esterase in the plasma. Therefore, if acetylcholine is prevented from reaching the receptor end-organs by its destruction through choline esterase, apparently no

contraction of the muscles can take place, or in other words, a paralysis of the respiratory and other musculature will result. The paralysis resulting from cobra venom is generally considered to be due to a neurotoxin with specific action on the respiratory centre and nerve endings. In view of the recent ideas with regard to the chemical transmission of nerve impulses, it was considered of interest to study the effect of cobra venom on acetylcholine-choline esterase system of blood. It was expected that some light on the possible mechanism of action of the venom might be obtained from this angle.

The blood serum of the cat was used as the source of choline esterase. The continuous titration method of Stedman, Stedman and White[13] was employed for the determination of enzyme activity using acetylcholine chloride as the substrate. The original activity of the serum expressed as c.c. of 0·032 N. NaOH has been compared with the activity of the serum under the influence of cobra venom in various concentrations. A very striking activating effect of the cobra venom, on the choline esterase content of the serum was noticed, the activation increasing with the concentration of the venom. The Russell's viper venom tested similarly failed to show any measurable effect. This marked activation led us to suspect the possible existence of choline esterase itself in the cobra venom. The two venoms (Cobra and Russell's viper venom) were therefore tested for their choline esterase activity without the addition of the serum. Three different specimens of the cobra venom which were stored in the laboratory for periods varying from six months to two years (Table I) were tested for their choline esterase content and in all three, a very powerful choline esterase activity could be demonstrated, the most recent sample (six months' old) showing the highest activity.

The specific nature of the activity of choline esterase was studied by Stedman, Stedman and Eason[14] and by Stedman, Stedman and White (*loc. cit.*). They have shown that liver esterase is without any appreciable action on esters of choline and that choline esterase exerts little, if any, action on simple esters such as methyl butyrate. Roy[15] studied the rate of hydrolysis of ethyl

TABLE I.

Substrate : acetylcholine, 0·25 gm., in 100 c.c. ; Enzyme : dried venom 10 mg. Period of reaction 1 hour.

Experiment ..	1	2	3
Age of venom (in months) ..	> 24	12	6
Activity (in c.c. of 0·0231 N. NaOH)	4·70	21·80	41·10

butyrate in the presence of cobra venom and showed that in high concentration (5 per cent.) and under prolonged period of incubation, cobra venom had a fairly strong esterase activity while this activity was almost negligible in low concentrations (0·2 to 0·02 per cent.). In our experiment with 0·005 per cent. venom, no hydrolysis of ethyl butyrate occurred in 20 minutes incubation, while under identical conditions, a marked splitting up of acetylcholine chloride could be demonstrated. This goes to show that the esterase present in the venom is predominantly of the type of choline esterase. The well-known inhibitory effect of eserine on choline-esterase was also tested. Cobra venom when mixed with eserin (physostigmine) in a concentration of 1/50,000, lost its cholin esterase activity considerably, indicating that probably the choline esterase in the venom is of an identical nature with the esterase in the blood serum. Russell's viper venom, on the other hand, did not show any measurable choline esterase activity.

The biochemical and pharmacological significance of this finding is interesting. The presence of choline esterase in cobra venom offers a new and fairly satisfactory explanation of the peculiar toxic manifestations (paralysis) produced by cobra venom on biological tissues. Cobra venom, as is well known, is characterised by an action on the nervous mechanism. The choline esterase in the venom will, when introduced into the system, naturally supplement the activity of the choline esterase already present in the blood serum, and will help in bringing about a complete destruction of acetylcholine. Without the mediation of acetylcholine, nervous impulses will not be transmitted to the respiratory muscles and a paralysis will

supervene. This view-point, however, does not satisfactorily explain the specific paralytic effect of the cobra venom on the respiratory centre. It has not yet been conclusively demonstrated that impulses in the central nervous system are carried through the mediation of acetylcholine, though Dikshit[16] (1934) has demonstrated the presence of acetylcholine in the ventricles of the brain and suggested that humoral transmission may also occur in the central nervous system. Further work on the different aspects of this interesting problem is in progress.

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[2] Faust, *Abderh. Handb.*, 1910, **2**, 815; *Arch. Exp. Path. Pharm.*, 1911, **64**, 244.
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[9] Chopra and Iswariah, *ibid.*, April 1931, **18**.
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Composition of Fusel Oil, Mandya Distillery.

Fusel oil is known to be of variable composition, depending upon the nature of material fermented, the kind of yeast and method of distillation. The fusel oil obtained during fermentation of Mandya molasses and subsequent distillation of spirits in the patent still, has hitherto had practically no demand in the market. It is of interest to know if any of its components can substitute imported products in varnishes and in other industries.

The fusel oil, sp. gr. 0·85, n_D^{27} 1·380, was distilled in a simple distillation flask when the propyl and *iso*butyl alcohols come over as binary aqueous mixtures (Table I).[1]

Table I.

Distillation of Fusel Oil.

B.P.° C.	Per cent.
78–86·5	11·8
86·5–87·5 ..	11·4
87·5–88	9·2
Water layer ..	2·5
88–89	11·9
89–96	11·4
96–115	7·0
115–120	2·5
120–125	4·6
125–132	27·7

About 800 g. of the oil were then dried repeatedly over anhydrous potassium carbonate and the dry oil fractionally distilled 4 to 6 times through Young's 4-bulb still-head. The specific gravities and refractive indices of the fractions were determined. The comparative optical rotation was observed with a sugar polarimeter in a 200 mm. tube (Table II). By oxidation of the fractions with potassium dichromate and sulphuric acid, oxidation products of the various alcohols were identified and *iso*propyl alcohol estimated (Messinger's method).[2] Ethyl alcohol was estimated by the method of J. Holmes, extracting the oil with brine and subsequent removal of the higher alcohols by petrol.[2] The presence of optically active amyl alcohol was denoted by the *lævo*-rotation of the higher boiling fractions.

TABLE II.

Fractional Distillation of Dry Fusel Oil.

B. P. Fraction	Per cent. Sample (*a*)	Per cent. Sample (*b*)	Opt. Rotn.	n_D^{27}	Sp. gr. 27
C°					
75–76	0·9	..	..	1·362	·7984
76–77	2·5	0·3	..	1·3625	·7989
77–78	4·4	4·5	..	1·363	·7995
78–79	5·3	5·4	..	1·365	·8019
79–80	1·5	4·3	..	1·366	·8041
80–82	3·4	7·4	..	1·368	·8076
82–85	1·5	3·7	..	1·371	·8097
85–90	1·2	2·5	..	1·375	·8095
90–95	3·5	0·6	..	1·3755	·797
95–100	3·8	0·9	−0·7	1·382	·796
100–110	4·0	2·2	−1·2	1·390	·7998
110–120	9·6	2·8	−2·3	1·397	·7998
120–125	11·9	1·8	−3·6	1·402	·802
125–128	27·1	40·6	−6·8	1·4045	·8045
128–130	3·4	3·0	6·5	1·405	·805

The earlier alcohol fractions were not entirely dry, but the use of barium oxide for drying resulted in losses, due to its combination with some of the alcohols and also mechanical losses.

From comparative determination of the properties of alcohols (Merck's) with distillate fractions from two samples of fusel oil taken (*a* and *b*)—III—it is found that the fusel oil has the approximate composition:—water—18%; ethyl alcohol—8%; *iso*propyl alcohol—0·5%; *n*-propyl alcohol—18%; *iso*butyl alcohol—5·5%; *n*-butyl alcohol—6%; *iso* and active amyl alcohol—41%; *n*-amyl alcohol—3% and traces of free acids—0·01%.

It is seen that this fusel oil can serve as a source for the higher alcohols and for fairly

TABLE III.

Components of Fusel Oil.

	Per cent. Sample (*a*)	Per cent. Sample (*b*)
Water	16·0	20·0
Ethyl alcohol ..	7·8	8·0
*Iso*propyl alcohol ..	10·4	0·5
Propyl alcohol ..	16·0	20·2
*Iso*butyl alcohol ..	7·8	3·1
n-Butyl alcohol ..	9·6	2·8
Iso and active amyl alcohol	39·0	42·4
n-Amyl alcohol ..	3·4	3·0

large supplies of amyl acetate for industrial uses.

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[1] *Distillation Principles and Processes*, by S. Young.
[2] *Alcohol*, by C. Simmonds.

Observations on the Liberation of Helium from Monazite by Heating.

THE preparation of helium from monazite is well known but as appreciable quantities of helium were required by us for our work on the adsorption of helium by charcoal (cooled in liquid air), several lots of monazite were heated under different conditions and the yield and rate of evolution of helium were studied.

The monazite employed was from Travancore, and it contained 7·2 per cent. of ThO_2. The main bulk (98 per cent.) of the naturally occurring material passed 40-mesh sieve and this was used for the heating experiments either in this condition or after crushing to 80-mesh.

The first set of experiments were carried out with a view to determine the temperature

and period for which the material available to us had to be heated in order to obtain a satisfactory yield of helium. The electric furnace used could be maintained approximately steady (± 10°) at temperatures up to 1,100–1,200° C. The purification of the gas obtained was effected as usual, the cocoanut-shell charcoal cooled in liquid air having been degassed previously in a Töpler vacuum by heating for over 24 hours in a bath of sulphur vapour. The measurement of the volume of helium was carried out in a constant volume burette[1] having two fixed glass pointers which corresponded to 2·742 c.c. and 9·380 c.c. respectively. The error in the determination of volume was not more than 1·5 c. mm. in any experiment.

As a result of several trials it was found that in order to liberate all the helium from the sample in a reasonably short period (4 hours), it was necessary to heat the material at a temperature of about 1,000–1,100° C. The quantities of helium obtained from the 40 and the 80-mesh samples were respectively 0·850 and 0·903 c.c. per gram of the material. The rate of evolution of helium when monazite is heated at 1,100° C. in a Töpler vacuum was studied, and the results of one typical experiment showing the quantities evolved during the progress of heating are given below :

Period of heating (in hours) ..	0—½	½—1	1—2	2—4	4—5
Helium obtained (percentage of total)	90·7	5·8	1·5	2·0	0·0

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[1] *J. Ind. Inst. Sci.*, 1934, 17 A, Part III, 36.

Spilitic Rocks from Chitaldrug, Mysore State.

In a short paper published a few years ago,[1] the present writer gave a general petrographic account of the trap rocks of the Chitaldrug Schist Belt. The present note deals with the Jogimardi trap (the Chitaldrug grey trap of some writers), and the dark hornblendic trap of Chitaldrug.

The Jogimardi trap is a grey coloured, heavy basic rock. It exhibits a great variety of textures, varying from glassy and fine-grained types, to coarse rocks with ophitic or sub-ophitic textures. Sometimes, these rocks are also porphyritic. Augite, mostly altered to uralite and chlorite, and decomposed plagioclase, constitute the important minerals. The feldspars are invariably altered, but in a few favourable cases it was possible to determine that the refractive index was distinctly lower than that of Canada balsam ; the species may therefore be referred to albite or acid oligoclase. Quartz occurs sporadically. Feebly pleochroic pale yellow epidote, and calcite are the common secondary minerals. Sphene and ilmenite are always present. These traps do not contain olivine or rhombic pyroxene.

The dark hornblendic trap is of a deeper colour than the Jogimardi trap, a character mainly due to the colour of the amphibole, which is deep-tinted with well-marked pleochroism from yellow to green to greenish blue. The feldspars are highly altered and so it is not possible to determine their exact nature. There is no augite in any of the sections examined by the writer. Magnetite, pyrites, and ilmenite occur as accessories. In a few cases, an ophitic texture is just discernible.

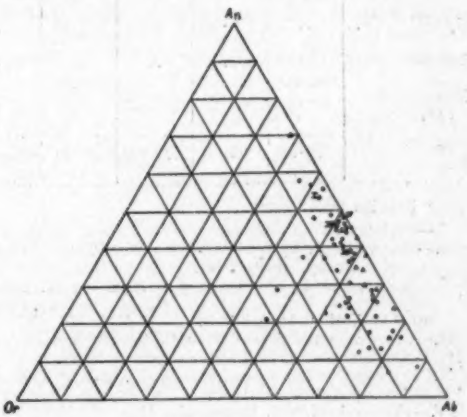

Fig. 1.

Molecular percentages of normative feldspars of spilites. British spilites are represented by triangles and the Chitaldrug rocks by circles. Spilites from other parts of the world are indicated by dots.

The chemical composition of these traps may be seen from the analyses given in the accompanying table. Columns I and II are analyses of Jogimardi traps, column III gives an average of I and II, and column IV is the analysis of a specimen of the dark hornblendic trap. Alongside these are placed, for purposes of comparison, the analyses of a few spilitic rocks from other parts of the world, as well as the composition of average spilite according to Wells and Sundius.

and a relatively high soda content, varying from 2.27 per cent. to 3·70 per cent. These are characteristic features of spilitic rocks, and in this respect, these rocks are comparable to the spilites from other parts of the world, though the percentage of soda is not so high as in the average spilites of Wells or Sundius.

The composition of the normative feldspars in these rocks is best seen by plotting the calculated molecules in an orthoclase-albite-anorthite triangle. This has been done

	I	A	B	C	II	III	D	E	IV	
SiO_2 ..	47·44	47·45	48·58	48·55	48·52	47·98	46·01	51·22	52·60	SiO_2
Al_2O_3 ..	16·28	17·54*	14·58	13·50	13·80	15·04	15·21	13·66	10·12	Al_2O_3
Fe_2O_3 ..	3·27	2·04	1·89	3·56	3·65	3·46	1·35	2·84	3·84	Fe_2O_3
FeO ..	9·76	7·44	7·65	10·20	9·83	9·79	8·69	9·20	12·73	FeO
MgO ..	5·20	6·72	6·36	7·37	5·88	5·54	4·18	4·55	6·17	MgO
CaO ..	11·22	10·96	9·80	8·58	10·92	11·07	8·64	6·89	9·36	CaO
Na_2O ..	2·94	3·93	4·02	2·94	3·70	3·32	4·97	4·93	2·27	Na_2O
K_2O ..	0·34	tr	0·43	0·32	0·32	0·33	0·34	0·75	tr	K_2O
TiO_2 ..	0·90	..	1·77	1·13	1·04	0·97	2·21	3·32	1·12	TiO_2
P_2O_5 ..	0·09	n.d	0·19	0·09	0·10	0·10	0·61	0·29	n.d	P_2O_5
MnO ..	0·18	n.d	0·46	0·27	0·14	0·16	0·33	0·25	0·03	MnO
H_2O ..	..	2·90	3·61	3·24	..	..	2·48	1·88	1·60	H_2O
Loss on ignition	2·19	..	..	..	2·12	2·15	..	..	..	Loss on ignition
Other constituents	..	0·55	1·29	0·16	..	..	4·98	0·94	..	Other constituents
	99·81	99·53	100·63	99·91	100·02	99·91	100·00	100·72	99·84	

* includes TiO_2.

I.—Jogimardi Trap, Chitaldrug, Mysore State. Analyst : E. R. Tirumalachar.
A.—Gwna Spilite, Bryn Llwd, Newborough Dunes, Anglesey. Analyst : J. O. Hughes (*Mem. Geol. Surv.*, 'Geology of Anglesey,' 1919, **1**, 74).
B.—Spilite, Mullion Island, Cornwall. Analyst : W. Pollard (*Mem. Geol. Surv.*, 'Geology of the Lizard,' 1912, 185).
C.—Greenstone, Valkeasiipivaara, Kiruna, Sweden. Analyst : A. Bygden ('On the spilitic rocks,' N. Sundius. *Geol. Mag.*, 1930, **67**, 6).
II.—Fine-grained Jogimardi Trap, Chitaldrug, Mysore State. Analyst : E. R. Tirumalachar.
III.—Average of Jogimardi trap analyses I and II.
D.—Average Spilite, according to A. K. Wells ('Nomenclature of the Spilitic Suite,' *Geol. Mag.*, 1923, **60**, 69).
E.—Average Spilite, according to N. Sundius (*Geol. Mag.*, 1930, **67**, 9).
IV.—Fine-grained dark hornblendic trap, Chitaldrug, Mysore State. Analyst : E. R. Tirumalachar.

It will be seen from the table of analyses that both these traps from Chitaldrug are characterised by a very low potash content (from just a trace in the dark hornblendic trap to 0·34 per cent. in the Jogimardi trap), in the accompanying diagram, where the circles represent the composition of the normative feldspars of the Chitaldrug traps. It will be noticed that their positions correspond very well with the normative feldspars

of other well-known spilites, and fall within a narrow zone along the plagioclase line.

It is well known that spilitic rocks often show the characteristic pillow structure in the field. The recently reported occurrence of pillow structure[2] in the Chitaldrug traps is, therefore, of special significance as indicating the spilitic character of these rocks which must have originated as submarine flows.

Attention may also be drawn here to two rock types associated with the traps of this area, which have been described by the late Professor P. Sampat Iyengar[3] under the names Talvati felsite, and Anabur (or Pitlali) granite. By the courtesy of the Director of Geology in Mysore, the present writer examined a few specimens and slides of these rocks, and it was found that the Talvati felsite is a dark compact rock with sub-conchoidal fracture, containing abundant rounded or oval grains of quartz which appear almost black in colour, with a few small phenocrysts of feldspar. The rock weathers grey or greyish white. Under the microscope, the feldspars are seen to occur in individual crystals, glomeroporphyritic aggregates, and as minute grains in the matrix. The index of refraction and angles of extinction indicate an albite of composition $Ab_{95}An_5$. The quartz grains are invariably deeply corroded and embayed. Greenish biotite occurs in small shreds and flakes. Thin veins of epidote traverse the rock. This rock corresponds in most particulars to a quartz-keratophyre.

The Anabur or Pitlali granite which borders the Chitaldrug Schist Belt for more than fifty miles, is a gneissose rock containing albite of composition Ab_{92} An_8.

Keratophyres, quartz-keratophyres, and soda-granites are invariably associated elsewhere with spilitic rocks. Therefore, the presence in the Chitaldrug area of these sodaclase bearing rocks associated with the traps is yet another argument which supports the view that here we have a suite of rocks belonging to the spilitic series.

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Bangalore,
July 28, 1938.

[1] Pichamuthu, C. S., *Rec. Mys. Geol. Dept.*, 1930, **27**, 20–32.
[2] Raghunatha Rao, B. N., *Curr. Sci.*, 1937, **6**, 279.
[3] Sampat Iyengar, P., *Rec. Mys. Geol. Dept.*, 1905, **6**, 64, 86.

A Study of the Feldspars from the Mica Pegmatites of Nellore.

THESE feldspars comprise different types varying in composition and mineralogical properties. The most common of these is an albite with a Na_2O content of about 10 per cent. and an orthoclase with a potash content of about 16 per cent. In addition to these two main types there are also found appreciable quantities of perthites and microperthites, the most conspicuous of these being a beautiful green moonstone composed of a perthite-microperthite. A flesh-red microcline with typical microcline structure is also present in large quantities.

A quantitative study of almost all the main types of these feldspars was carried out both chemically and microscopically. The potash member in the flesh-red specimens of perthites and microperthites was found to be microcline, while in the other specimens, it was a moonstone of an orthoclase type. In the green feldspars the potash member is always green having very fine microcline twinning. The presence of this microcline twinning led to the common and erroneous view that this feldspar was microcline. But it differs from microcline in many of the essential optical properties. Sections cut parallel to (*001*) show straight extinction with reference to the trace of (*010*) cleavage. In addition, sections cut parallel to (*010*) show almost symmetrical interference figures in convergent polarized light. These observations show that it is not microcline but a moonstone of the orthoclase type. It is not anorthoclase as its sodium content was found to be very low. The microcline structure is perhaps an anorthoclase effect produced by that portion of albite which is in solid solution in the potash member.

Results obtained from chemical and micrometric data show definitely that mutual solubility exists between the *Or* (potash member) and *Ab* members on the one hand and *Ab* and *An* members of these feldspars on the other, whereas the *Or* and *An* members are not miscible. It is also noticed that *Ab* is more soluble in *Or* than *Or* in *Ab*.

The perthitic structure and the microcline twinning of these moonstones are not destroyed by heat, but continued heating at a tempearture of about 1000° gives rise to a change in the potash member at its contact with the albite member. The sharp contact

disappears and one notices a somewhat coarse area which does not extinct simultaneously with either of the feldsapar members.

Almost all the coloured feldspars, excepting the flesh-red ones, lose their colour on heating them to 300°. The green moonstone perthite changes into a pearl-white feldspar which retains all the original properties excepting the colour.

Though almost all the perthites examined exhibit the schiller phenomenon, the colours shown by them are not real schiller colours, but are produced by a metallic impurity, probably iron, which occurs as a ferrous compound in the green feldspars, and as a ferric compound in the flesh-red feldspars. In these feldspars no correlation could be found between the nature of the microperthitic structure and the colour, but the schiller behaviour which is always white in these feldspars is due to the microperthitic structure.

The flesh-red feldspars which contain the maximum amount of iron owe their colour to the microcline portion which holds numerous ferruginous vesicles distributed throughout its mass.

The green feldspars owe their colour to a green turbidity, probably due to a ferrous silicate which occurs as green cloudy patches within the body of the feldspars. Heated specimens do not show any special areas of turbidity. It appears therefore that the loss of colour is due to a change in the state of aggregation of the iron compound present in the feldspar.

In conclusion, I wish to express my heartfelt thanks to Dr. K. R. Krishnaswamy for suggesting the problem and for the valuable guidance given to me throughout the work.

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July 7, 1938.

An Important Genetic Constant.

WORKERS on the inheritance of quantitative characters of the plants have all along been handicapped in obtaining rigidly true comparisons between the characters of the first hybrid progeny with those of subsequent generations, mainly due to the difficulty of obtaining a fairly large population of F_1 plants. In most cases workers had to depend on the insufficient data collected from a few plants of the F_1 and attempted to compare the same with data obtained from large populations of subsequent generations. The difficulty and labour involved in raising F_1 progenies every time when comparisons had to be made, have again forced a few workers to attempt comparing the data obtained in any one season with the data of F_1 collected in a different season under quite different environmental conditions. This, no doubt, is an erroneous procedure, since environment has a great modifying effect on the expression of any character, but it could not be helped.

The author of this note has for some time been thinking to find a way out and to determine a constant whereby it should be possible to predict the average value of any quantitative character in the F_1 from the average values obtained for that character in any particular year for the parents and the total F_2 population. For instance, if the average height or the tillering capacity in cereals of both the parents and the F_2 population grown under the same set of conditions are known, it should be possible with the help of a constant to gauge the average value of that particular character for the F_1 without the necessity of growing the F_1 at the same time. Taking the published data of several workers, and working out hundreds of them, it has been found possible to find that a definite relation exists not only between the parents, F_1 and F_2, but it also exists between the parents and any two successive generations. In all the cases worked out, it was found out that the sum of the averages of any quantitative character of both the parents and the F_1 was more or less three times the average for the F_2. It was also observed that the value of this constant holds good whether the average value of the F_1 was intermediate, more or less than either of the parents. Data obtained by East,[1] Hayes,[2] Shaw,[3] Engledow and Pal[4] are in entire agreement with the view expressed above. Data from other workers will be included in a subsequent paper. A few instances out of the data of the above-said workers are set forth in Table I.

TABLE I.

Cross between 1st Parents = A 2nd Parents = B	Character studied	Parent A	Average of Parent B	F_1	F_2	Constant K
1. 383 × 330 Tobacco	Corolla-Length in cm.	93·20	40·56	63·50	67·40	2·93
2. Cuban × Havana Tobacco	Number of leaves per plant	20·60	20·30	19·80	20·90	2·93
3. 80 × 5 Rahar	Height in cm.	251·00	320·62	255·91	276·85	2·99
4. Joss × Thule Wheat	No. of tillers per plant	100·00	62·00	133·40	96·00	3·08
Do.	Grain-yield per unit area	100·00	74·20	114·00	94·70	3·04
				F_2	F_3	
Do.	No. of tillers per plant	100·00	62·00	96·00	85·65	3·01
Do.	Grain-yield per unit area	100·00	86·36	84·70	89·34	3·00

It may also be mentioned here that once the value of the constant is known, it is possible to predict the values of F_3, F_4, etc. From the data of the parents and the F_2, taking A and B as the average values of the parents and 3 as the constant, it is now possible to say that $A + B + F_1 = 3F_2$; $A + B + F_2 = 3F_3$; $A + B + F_3 = 3F_4$ and so on.

The importance of this constant to plant-breeders is, therefore, self-evident and needs no further explanation.

CH. NEK ALAM.
Department of Agriculture,
Gurdaspur,
May 25, 1938.

[1] East, *Genetics*, 1916, **1**, 164–76.
[2] Hayes, *Comm. Agr. Exp. Sta. Bull.*, 1912, **171**, 1–45.
[3] Shaw, *Ind. J. Agric. Sci.*, 1936, **6**, 139–87.
[4] Engledow and Pal, *J. Agric. Sci.*, 1934, **24**, 390.

Nitrogen Fixation in Relation to Weve-length.

IN publications by Dhar and Collaborators,[1] it has been shown that the addition of energy-rich substances to soil leads to fixation of nitrogen and that this type of nitrogen fixation is enhanced when the soil mixed with energy-rich materials is exposed to sunlight. These conclusions have been found to hold good in artificial bulb light also which excludes most of the ultra-violet rays.

Having obtained the definite evidence for the fixation of nitrogen in the artificial bulb light, the author has investigated the region which is most effective in bringing about the fixation and this note deals with the preliminary results obtained in this direction. Various light filters transmitting different regions of the visible part of the spectrum were used. 50 g. of well powdered garden soil was taken in a beaker, the sides and bottom of which were coated with Japan black to exclude light and allow light to pass only through the filters covering the top of the beakers. 25 c.c. of sugar solution containing 0·5 g. sucrose was added to the soil and mixed thoroughly and the mixture analysed for original carbon and nitrogen.[2] The soil was then exposed to light from a 1,000 watt bulb and the soil analysed again after an exposure of 300 and 400 hours. The following experimental results were obtained (Table I).

The results (Table I) are very interesting and important in that they show the region which is most effective in bringing about the fixation of nitrogen consequent on the addition of sugars to soil and exposure to light. It can be clearly seen from the table

TABLE I.

Original Analysis C : 0·575
N : 0·044.

Analysed after	Dark	Red 0·6–2·5 μ	Yellow 0·527–0·517 μ	Amber 0·4–0·75 μ	Dark blue 0·65– ·75 μ 0·3 –0·5 μ	Fl Yellow 0·55–0·20 μ	Sig Yellow 0·5–0·75 μ
300 hrs. C :	0·472	0·427	0·353	0·375	0·339	0·330	0·344
N :	0·045	0·045	0·050	0·050	0·051	0·053	0·052
400 hrs. C :	0·441	0·425	0·353	0·367	0·338	0·329	0·333
N :	0·045	0·046	0·044	0·044	0·044	0·049	0·045

that the maximum fixation was observed in the yellow region (0·55–2·0 μ).

Futher experiments are in progress to elucidate the real significance of different wave-lengths of light on non-symbiotic fixation of nitrogen.

The above experiments were undertaken in the Chemical Laboratories, Allahabad University, and the author's grateful thanks are due to Prof. N. R. Dhar for his generous help.

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Department of Biochemistry,
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Bangalore,
May 3, 1938.

[1] Dhar and Mukerji, *J. Ind. Chem. Soc.*, 1936, **13**, 155; *Nature*, 1936, **138**, 1060.

[2] Robinson, McLean and Williams, *J. Agric. Sci.*, 1929, **19**, 315.

Transgressive Segregation in Structural Hybrids.

THE modes of chromosome conjugations in structural hybrids lead to formation of new types of chromosomes (Müntzing, 1934;[1] Kostoff, 1935,[2] 1936,[3] 1937,[4] Darlington, 1937,[5] etc.). Breeding further such hybrids, one can produce forms with new karyotypes in homozygous condition. When such forms are crossed with the parental forms (species or varieties) new types of structural hybrids can be produced (*cf.* Kostoff, 1937*b*[6]), which might further give rise to new karyotypes.

Propagating the hybrids *Triticum vulgare* ($2n = 42$) × [*Tr. turgidum* ($2n = 28$) × *Tr. dicoccum* ($2n = 28$)] and [*Tr. vulgare* ($2n = 42$) × *Tr. monococcum* ($2n = 14$)] × *Tr. persicum* ($2n = 28$), I obtained in fourth, fifth and sixth generations several homozygous forms so far as the visible morphological characters and the time of flowering are concerned. One *Tr. turgidum*-like derivative ($2n = 28$) from the first triple hybrid and one *Tr. persicum*-like derivative ($2n = 28$) from the second triple hybrid were crossed. The plants obtained from this cross were structural hybrids, forming usually (1) one quadrivalent, or (2) one trivalent and one univalent, or (3) two univalents (Fig. 1), while

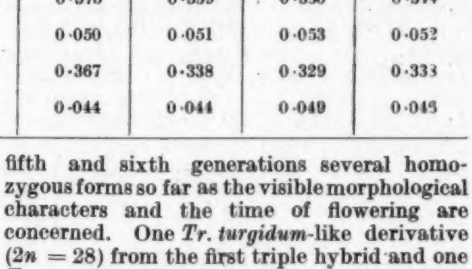

FIG. 1.

Four meiotic metaphases with trivalents, quadrivalents and univalents from the structural hybrid between *Tr. turgidum*-like and *Tr. persicum*-like derivatives. It does not seem that in all instances the same four chromosomes are involved, because I found in a pollen-mother cell two trivalents and two univalents.

the hybrids *Tr. turgidum* × *Tr. persicum* obtained from the normal species *Tr. turgidum* and *Tr. persicum*, which have participated in the triple crosses mentioned above, had normal meiosis.

The latter hybrids *Tr. turgidum* × *Tr. persicum* segregated in F_2 generation like intraspecific hybrids. In studying 303 (+ 6) hybrids in F_2 generation, I found that in respect to the characters: the length of the grains, the length of the awns, the breadth of the leaves, the number of the spikelets in the spike, and the pubescence on the nodes of the stem, no transgressive segregation takes place. Five F_2 plants out of

309 began to flower several days before the earlier parent (*persicum*), twelve plants began to flower several days after the late parent (*turgidum*) and six plants began to flower more than 10 days after the late parent. In other words, a noticeable transgressive segregation was only found in respect to the vegetation period.

The mode of segregation of the structural hybrids produced in crossing *Tr. turgidum*-like derivative with *Tr. persicum*-like derivative was quite different. I studied only 84 plants of this cross in F_2 generation. Three F_2 plants had much broader leaves than either parent. One of these plants had 18 mm. (16 to 20 mm.) broad leaves. Two plants had very narrow leaves reminding of those in *Lolium perene* and *Poa pratensis*. Three plants had much shorter awns than either parent. One plant had much longer grains than either parent. Two plants were dwarfs forming deformed spikes. One plant formed very narrow, but elongated spikes like those in *Agropyrum*. Three plants had less spikelets in the spikes and one had many more than the parental forms. I had also the impression that the hairs on the nodes of two F_2 plants were much longer than in *Tr. persicum*-like derivative. In respect to the flowering period five plants flowered earlier than the early parent and nine flowered later than the later parent. One plant did not form spikes at all, *i.e.*, it was a winter type. These observations show clearly that structural hybrids give a more striking transgressive segregation with broader amplitude than the normal (non-structural) hybrids. It is generally assumed, that transgressive segregation in normal hybrids is due to recombination of polymeric genes. When form $A_1 A_1 a_2 a_2$ is crossed with form $a_1 a_1 A_2 A_2$, F_1 hybrids $A_1 a_1 A_2 a_2$ and transgressive homozygous forms $A_1A_1A_2A_2$ and $a_1a_1a_2a_2$ are obtained. The same recombinations can take place in structural hybrids too. But in addition to these, another kind of phenomenon, namely, the exchange of segments between partially homologous chromosomes, makes the transgressive segregations more striking, involving many more characters. The mode of chromosome conjugations in structural hybrids create conditions for exchange of chromosome segments which leads to formation of gametes and further of zygotes and plants with gain (duplications) or loss (deficiencies, deletions or both) of chromosome segments. Consequently, the transgressive segregation in structural hybrids is due to polymeric genes and to chromosome rearrangements.

A very striking transgressive segregation was found in F_2 generation of a structural hybrid between *Tr. vulgare* (Novinka) and a *Tr. vulgare* type, derivative from wheat-rye hybrid. The transgression affected the breadth of the leaves, the number of the flowers per spikelet, the number of the spikelets per spike, the vegetation period (even winter types were segregated) and the length of the pubescent part below the spike. The wheat-rye *Tr. vulgare*-like derivative had hairs below the spikes, like *Secale cereale* covering a portion of about 1 cm. In F_2 generation I found plants, that had hairs immediately below the spike which spread down until 8–10 cm.

Intraspecific hybrids, between varieties originating from different geographical localities, might often be structural hybrids. They then segregate in the way described above, giving occasionally various kinds of abnormal plants. The mode of segregations of the varietal hybrids in barley described by Karpechenko (1934[7]) suggest strongly that he has obviously dealt with structural hybrids. Liepin (unpublished) observed recently a similar type of segregation from a cross between two varieties of *Tr. durum*, one (*arraseita*) originating from Abyssinia. His hybrid has probably been also a structural hybrid. I studied cytologically two hybrids between *Tr. persicum* var. *stramineum* and *Tr. durum*. In one of them var. *arraseita* has participated while in the other one Mediterranian form of *Tr. durum* was the component. The hybrid with the Mediterranian variety had normal meiosis, while the hybrid with *Tr. durun arraseita* was a structural hybrid forming polyvalents and univalents.

Broad amplitudes of transgressive segregations of structural hybrids are of great practical value. Plant-breeders usually attempt to produce transgressive forms in respect to various quantitative characters, by varietal hybridisations. The offsprings of structural hybrids represent in this respect populations with more desirable forms. *Progenies of structural hybrids have also great evolutionary significance.* (1) The populations derived from structural hybrids have greater diversity of forms and offer a more abundant material

for natural selection. (2) Structural hybrids have various degrees of reduced fertility. Plants with new homozygous karyotypes, that originate from structural hybrids, will be partly isolated and might get further differentiated into separate forms.

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June 27, 1938.

[1] Müntzing, *Hereditas*, 1934, **19**, 284–302.
[2] Kostoff, *Sbornik (Annals) Czechoslovak Acad. Agric.*, 1935, **10**, 389–402.
[3] Kostoff, *Bull. Acad. Sci., USSR., Biol. Ser.*, 1936, **1**, 5–22.
[4] Kostoff, *Cytologia Fujii*, 1937 *a*, Jub. Vol., pp. 262–77.
[5] Darlington, *Recent Advances in Cytology*, London (1937).
[6] Kostoff, *Curr. Sci.*, 1937, **5**, 537.
[7] Karpechenko, *Agric. Sci. in USSR.*, pp. 21–33.

On a New Species of *Isoetes* in India.

THERE is a wide-spread belief amongst the botanical circles in India, that *Isoetes coromandelina* L. is the only species of that genus occurring in this country.[1] This is largely due to the fact that all the specimens collected at different places by various workers[2] happened to belong to that species. In October 1935, however, I came across a small form of *Isoetes* at higher elevations in the Sahyadris, which on critical examination turned out to be a new species. The object of the present note is to give a short account of this new Indian species of *Isoetes*.

Type Characters.

Corm 3-lobed, small, without sheaths; leaves 7–15, 7–20 cm. long, slender, cylindrical and dark green; stomata numerous on the upper part of the leaf; air chambers 4; *peripheral strands none*; ligule cordate, slightly lobed on the flanks; sporangium 2 mm., more or less round, *covered by a complete velum leaving only a slit-like aperture at the base*; megaspores 325–430 μ in diameter, cream coloured when dry, dark brown when wet, studded with large uneven tubercles particularly on the lower facet; commissural ridges prominent; microspores 30 μ in diameter, marked with small spines; plants ambisporangiate.

Occurrence—"The mountain lake on the table-land at Panchgani (Bombay Presidency), 4,500 ft. above the sea-level."

"In pondson the grassy tops of the Kalahattigiri, Baba Budhangiri and other peaks of Sahyadris in the Mysore State."

Habit—"Occurring at the close of monsoons on the margins of ponds in the midst of what may be called *Ammania-Eriocaulon* association."

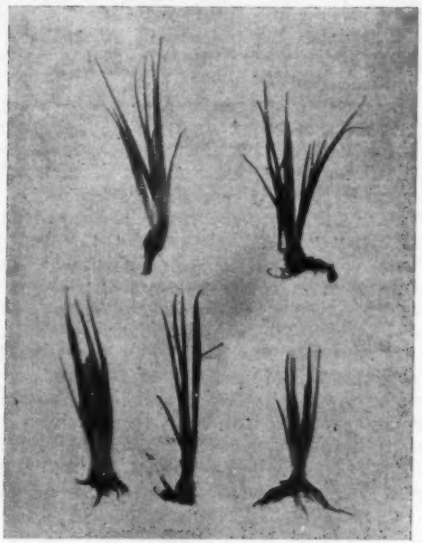


FIG. 1.

Systematic Position.

The species belongs to the group "*Subaquaticæ*" of Baker[3] and to the group "*Tuberculatæ*" of Pfeiffer[4]. It is closely allied to *I. alpina* Kirk[5] from New Zealand and *I. Muelleri* A. Br.[6] from Australia; but it differs from them in size and markings of the megaspores, number and the length of the leaves and the shape of the ligule. As it does not totally agree with both these species in such important diagnostic features, and again as it is separated from them by a wide geographical gulf from both of them, it is better to separate it from them. Accordingly it has been separated and provisionally called *Isoetes Sahyadrii* sp. nov.*

* *Isoetes Sahyadrii* Mahabale, sp. nov. Cormus trilobatus, parvulus, sine vaginis; folia numero 7–15, longitudine 7–20 cm., angusta, cylindrata, fusco viride; plumeris stomatibus instructa in superiore facie folii et quatuor aeris cellis et fibrosis peripheriis nullis. Ligulæ cordatæ leviter lobatæ ad latera. Sporangium plus minusve rotundum, 2 mm. undique velo coopertum præter levissimam reticulam prope basim. Macrosporæ diam. 325–430μ, gilvæ qum sunt aridæ, fuscæ fulvræ si madefactæ sunt, tuberculis crassis horridis ornatæ præcipue in inferiore latere, costis commissuris prominentibus. Microsporæ longitudine 30 μ, instructa spinulis: plantæ ambisporangiatæ.

The type specimens[7] are deposited in the Department of Biology, Gujarat College, Ahmedabad (India).

T. S. MAHABALE.

Department of Biology,
Gujarat College,
Ahmedabad,
July 18, 1938.

[1] Pfeiffer, N. E., "Monograph of the Isoetaceæ," 1922, pp. 110.

[2] Griffith, *Rec. Bot. Sur. India*, **3**, 327; Ekambaram, T., and Venkatanathan, T. N., *Ind. Bot. Soc.*, 1933, **12**, 194; Pfeiffer, N. E., *loc. cit.*; McCann, *J. Bom. Nat. Hist. Soc.*, 1934, **37**, 501; Misra, R. D., *Proc. Ind. Sci. Congress*, 1935, **22**, 254.

[3] Baker, *Fern Allies*, 1887, 123–34.

[4] Pfeiffer, N. E., *loc. cit.*, 104.

[5] Pfeiffer, N. E., *loc. cit.*, 122; Baker, *loc. cit.*, 127.

[6] Pfeiffer, N. E., *loc. cit.*, 127; Baker, *loc. cit.*, 127.

[7] The specimens of this new species were first exhibited at Calcutta on 7–1–1938 at the Botanical Exhibition held on the occasion of the annual meeting of the Indian Botanical Society.

Osteological Abnormalities in *Rana tigrina* Daud.

MANY cases of osteological abnormalities have already been described in frogs. Thus, for example, Boulenger,[1] amongst other individual variations, records an interesting, anomalous mode of articulation of the vertebræ in the Pelobatid frog *Xenophrys*. Adolphi[2] describes abnormalities in the vertebral column of *Bufo variabilis*. Bateson[3] recapitulates and discusses vertebral variations described by such previous authors as Goette,[4] Camerano,[5] Bourne,[6] Howes,[7] etc. Nicholls,[8] while describing the normal structure of the urostyle in *Rana tigrina*, gives an account of certain variations in it. Rao[9] mentions the abnormalities in the girdles and femur of *Rana tigrina*. Noble[10,11] remarks on the deviations found in the vertebral column of certain Anura. Thirumalachar[12] comments upon a unique case of the segmentation of the urostyle in *Microphyla rubra*, and also describes the fusion of certain vertebræ with each other and with the urostyle in *Rana hexadactyla*.[13] Raichoudhry and Das[14] describe the malformations in the vertebral column of *Bufo*. Ramaswami[15,16] notes the vertebral variations found in *Rana curtipes*, *Rana tennuilingua*, and *Megalophrys major*. Zaharesco[17] reports on the numerical variations in the vertebral column of *Rana esculenta*; and Remane[18] sums up the individual variations in the number of vertebræ of some Anurans.

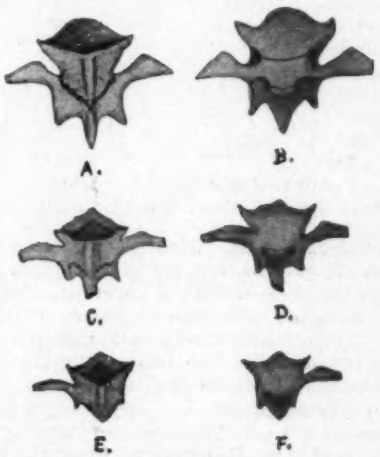
In the present article are described some interesting cases of abnormalities, found during the course of a careful examination of over a hundred skeletons of the common bull-frog *Rana tigrina*. Such abnormalities are obviously very rare, and some of the present ones, at any rate, are being described for the first time.

VERTEBRAL ABNORMALITIES.

I have come across seven cases of fusion of successive vertebræ: three between the first and the second vertebra, one between the fifth and the sixth, and three between the eighth and the ninth.

(*a*) ***Fusion between the first and the second vertebra.***—Of the three cases of fusion between the first and the second vertebra, one (Text-Fig. 1, *A* and *B*) resembles the normal condition very closely, the only difference being that instead of the intervertebral articulation, there is an immobile junction between the two. The line of demarcation between the fused vertebræ is distinct all round, and the intervertebral foramina are present as usual.

In the second case (Text-Fig. 1, *C* and *D*), the fusion is more complete, and the demarcation between the two vertebræ has entirely



TEXT-FIG. 1.

Abnormalities of the first and the second vertebra. *A*, *C*, *E*—dorsal views; *B*, *D*, *F*—ventral views.

disappeared except for a slight indicating depression on the dorsal side. The intervertebral foramen on the left side is absent, while on the right there is a narrow pit superficially just anterior to the transverse process, and a similar depression inside the neural space. Correlated with this absence of the intervertebral foramina, there must have been an abnormality in the first pair of spinal nerves: these might have been absent, or might have emerged between the second and the third vertebra instead of between the first and the second.

In the third case (Text-Fig. 1, *E* and *F*), the fusion is the most complete, and the two vertebræ have become a single entity, with no separating lines visible on any side. The intervertebral foramina have disappeared, leaving not the slightest trace, and even the transverse process is totally absent on the right side.

Arranged in a series, the three cases show a gradual process of compacting between the atlas and the axis, so that the proportionate antero-posterior length is the maximum in the first case, and the minimum in the third, the proportion being like the normal, unfused ones in the former case.

(*b*) ***Fusion between the fifth and the sixth vertebra.***—I have discovered only one case of this type (Text-Fig. 2). The fusion is quite complete, although the joining surface is

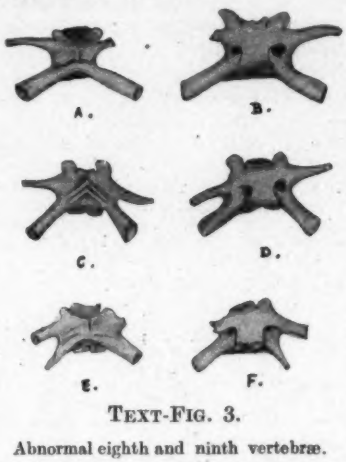
TEXT-FIG. 2.

Abnormal fifth and sixth vertebræ.
A—dorsal view ; *B*—ventral view.

distinct all round. The intervertebral foramina are present, but the neural spines have fused together so that a groove-like depression alone distinguishes the place of fusion. The right transverse process of the fifth vertebra and the left one of the sixth are broken near their roots.

(*c*) ***Fusion between the eighth and the ninth vertebra.***—I have found three cases of this kind of abnormality, and in all of them the fusion is complete.

In the first case (Text-Fig. 3, *A* and *B*), the two component vertebræ, which have compactly come together, do not show any special abnormality. The transverse process, the intervertebral foramina, the anterior



TEXT-FIG. 3.

Abnormal eighth and ninth vertebræ.
A, C, E—dorsal views ; *B, D, F*—ventral views.

facet of the eighth vertebra and the posterior one of the ninth are normal. The fusion, however, is so complete that it is difficult even to distinguish the joining zygapophyses of the two vertebræ from each other, there being only a small nodule-like projection in their place.

The second case (Text-Fig. 3, *C* and *D*) is, to all intents and purposes, a replica of the first. Here, however, the right transverse process is directed not straight outwards as is the case in a normal skeleton, but obliquely backwards, nearly parallel to the transverse process of the ninth vertebra, an arrangement perhaps to give additional support to the ilium of this side.

In the third case (Text-Fig. 3, *E* and *F*), there are several features of interest. The two vertebræ have very compactly grown together and the bilateral symmetry is apparently disturbed. Not only is the hollow anterior surface of the centrum of the eighth vertebra placed obliquely, but the transverse processes also are irregularly developed. On the right side the normal arrangement is visible as the transverse process of the eighth vertebra (distally broken) is slender and the posteriorly-directed transverse process of the ninth vertebra is stout having evidently served for the attachment of the ilium. On the left, however, it is the transverse process of the

eighth vertebra (and not that of the ninth) which is stoutly formed and is adapted for ilial articulation. The left transverse process of the ninth vertebra is slender in build and abnormal in direction, being pointed obliquely backwards and downwards.

The causes of such abnormal fusion of successive vertebræ are not quite clear. It appears, however, that these abnormalities are in some way related to the points of greater strain on the backbone in the movements of the animal. The fusion occurs more commonly either between the first two or the last two vertebræ and is extremly rare between the middle vertebræ. The leaping of the frog puts an exceptional stress on the ninth vertebra with which the pelvic girdle is connected and thus this vertebra may be occasionally reinforced by fusion with the one preceding it. Similarly, the movements of the head put a stress on the first vertebra, with which the second is often fused.

In this connection it might be mentioned that Koch[19] and Ruckes[20, 21] lay a great emphasis on the interpretation of the vertebrate skeleton on the basis of the laws of mechanics, more particularly on the determination of the stresses present on certain bones.

The phenomenon of vertebral fusion is a common feature in certain other Anura and it is believed that the limited number of the presacral vertebræ in this group has arisen through this phenomenon. Remane[22] in this connection says that in the Aglossa, *Atelpous* and in other genera (*Pelobates*) vertebræ 1 + 2 grow together as an individual variation, in *Hymenochirus* also 7 + 8 + 9, in *Dendrobates typographus* and *D. tinctorius* 2 + 3 and 8 + 9, in a few other species of this genus 1 + 2 + 3 and 8 + 9.

Abnormalities of the Pelvic Girdle.

Two cases of abnormal development of the pelvic girdle have come to my notice and both refer to the form of the ilium. The first case (Text-Fig. 4, *B*) concerns the left ilium while the second concerns the right. In the former, this bone instead of ending anteriorly in a straight cylindrical extremity, possesses a large downwardly-directed process, the shape of which is clear from the figure. In the latter, the ilium is not straight but irregular in direction and shows a point midway at which it is angularly bent outwards. The ridge is uneven and ends anteriorly in a rounded bony prominence.

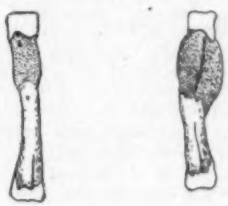
Both these cases might have been due to fracture and regrowth of the ilia, although it is difficult to be certain about it.

Text-Fig. 4.

A—Normal pelvic girdle from right side ; *B*—Abnormal pelvic girdle—right side ; *C*—Abnormal pelvic girdle—left side.

Abnormalities of the Tibio-Fibula.

Three cases of abnormality of tibio-fibula have come under my observation ; two of the right, and one of the left. Of the former, one (Text-Fig. 5, *B*) showed a very large



Text-Fig. 5.

Abnormal Tibio-fibula.
A and *B* are different specimens.

irregular, granulated dilatation from its middle up to the distal epiphysis ; and the other showed a similar one, less marked, almost smooth, and reddish in appearance. The left (Text-Fig. 5, *A*) abnormal tibio-fibula has also a dilatation like the first right one although not so extensive. All three cases

may be due either to the fracture of the bone during life, or to its necrosis.

I should like to express my deep sense of gratitude to Mr. Beni Charan Mahendra, whose continuous guidance and help has made the present work possible. I am also indebted to Dr. Baini Prashad for the loan of two journals and to Dr. L. S. Ramaswami for a typed copy of Dr. Thirumalachar's paper.

MAHESWAR SINGH SOOD.

Department of Zoology,
St. John's College,
Agra,
May 20, 1938.

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Coxal Interlocking in the Lepidopsocidæ (Copeognatha) and its Probable Taxonomic Value.

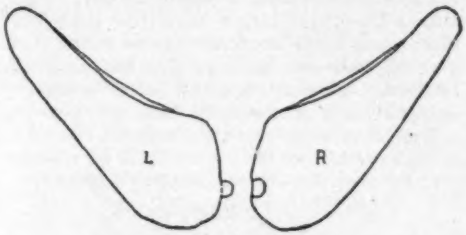
MORPHOLOGICAL studies made on some Indian Copeognatha enable me to record a curious coxal interlocking arrangement, which I believe has not yet been observed among insects. This arrangement occurs in four new species of Lepidopsocidæ belonging to four different genera. One is a species of *Thylacopsis*; another, of *Lepidopsocus*; the third, an *Udamolepis*; the fourth cannot be assigned to any of the existing genera and is therefore placed in a new genus, *Mediosoa*.* In the natural position, when observed from the ventral side, the meso-coxæ of these insects appear to be somewhat buttoned up together. On closer scrutiny it is found that a condylelike protuberance on the inner side of the left meso-coxa fits exactly in a corresponding cup-shaped cavity on the right meso-coxa.

It is surmised that by this ball and socket interlocking device the meso-coxæ can be made to move together as if they form a single piece. This arrangement must obviously be meant for jumping. It has been observed that these insects ordinarily move about by walking, but when disturbed they take recourse to hopping. This behaviour is not surprising since their wings are degenerate and useless for flight.

There is not sufficient record yet available to show in which genera of the family Lepidopsocidæ this coxal arrangement is present. Pearman observed such an arrangement in a specimen of *Soa*. It is not found in a species of *Lepolepis* which I possess and also in *Lepidila kellogi* Rib. which has been examined by Pearman. It is quite probable that this arrangement is absent

* The detailed descriptions of these species will be given in a subsequent contribution.

in other species of *Lepolepis* and *Lepidilla* as well. From a study of the various characters of the family Lepidopsocidæ and



Meso-coxæ of *Mediosax*, Gen. et sp. n.

the occurrence of this coxal arrangement in some species, I am inclined to believe that this family consists of two natural groups which may be assigned sub-family ranks and easily separated.

Before concluding I wish to record my sincere thanks to Dr. C. J. George for kindly going through the manuscript and offering his much valued suggestions and criticisms.

M. G. Ramdas Menon.

Department of Biology,
Wilson College,
Bombay,
June 29, 1938.

Sulaiman's Predictions.

To my article published in *Current Science*,[1] Prof. Madhav Rao has added a reply.

1. The first objection is as to the title of my article, and he has suggested that it savoured more of personal advertisement than of a genuine scientific controversy. I was replying jointly to two different criticisms, the second of which had not even initials appended to it; and both of which were directed against my predictions. I chose a title which was applicable to both and, I maintain, was appropriate. When I am challenging the theory of the greatest Mathematician of this century, I am not at all ashamed of advertising my predictions, one of which has already received a remarkable confirmation and the result of the second is still awaited. As to the third, the performance of an experiment is being looked for.

2. Replying on behalf of Sir C. V. Raman, Prof. Madhav Rao has taken objection to my submission that according to my theory the excess of the deflection of light over Einstein's value should be at least 33 per cent. He has called it so indefinite as scarcely to be taken seriously. Apparently Prof. Madhav Rao has forgotten the reply which I published to his criticisms of my theory in *Current Science*.[2] Perhaps the reason is that on that occasion he had not taken up my challenge to reply separately to the 60 points which I had numbered serially, but he contented himself with certain general remarks only. It was pointed out by me there that the upper maximum value of the deflection of light is 3/2 times Einstein's value. When the two limits have been fixed, there is no indefiniteness at all. He has also overlooked what I pointed out on p. 458 of my last reply that owing to certain deficiency in measurement and omission of a correction the value increases gradually as one proceeds from the limb farther away.

3. Prof. Madhav Rao has quoted in italics Dr. Royds' conclusion that the Relativity theory or any other theory requiring a general displacement of solar wave-lengths is not adequate to furnish a complete explanation of solar displacements. I am glad that Prof. Madhav Rao admits that the Relativity theory is not adequate to furnish such an explanation. As to my own theory it is not at all clear whether Dr. Royds ever had it in his mind, as there is certainly no reference to it in his paper, much less to my point that to test the value a curve should be drawn for the difference between the spectral shift at different points and that at the centre for lines of equal intensity.

4. Prof. Madhav Rao imagines that I had misunderstood Evershed's reference to the hypothetical observer on the planet Pluto and explains that Everhsed had used the illustration to emphasize that Relativity gives a satisfactory explanation of the solar spectral shift "in a general sort of way". If all that Relativity can claim is an explanation *in a general sort of way*, it will have to admit defeat. As a matter of fact the critic has himself misunderstood my point altogether. In text-books on Relativity the value of the spectral shift of light from Sirius B has been claimed as a brilliant triumph of Relativity. That is what I was

refuting when I said that were we at Sirius wherefrom the solar shifts from the centre and the edge would be indistinguishable, we could persuade ourselves to be convinced of a brilliant triumph of Relativity. I would certainly have suggested an observer in the Andromedia Nebula wherefrom the solar system itself would not be seen if any champion of Relativity could have claimed any brilliant triumph on account of the spectral shift from such nebula, apart from the now exploded " Expanding Universe".

5. Prof. Madhav Rao thinks that I regard every failure of the Relativity theory as a triumph for my own. I certainly regard every failure of the Relativity theory as a triumph for me because it falsifies the postulates which I have repudiated. I believe that when such failures are demonstrated, the new generation of Mathematicians and Scientists, no longer overawed by authority, would unhesitatingly reject such postulates as that the finite velocity of light relative to any moving body howsoever fast it may be moving and no matter whether light be overtaking it or receding from it, is always the same, or that the time taken by light to come from one nebula to another would be exactly equal to the time taken by light to come from the second to the first, even though both the nebulæ be moving forward in the same direction with tremendous velocities.

6. Prof. Madhav Rao still relies on the remark of Dyson and Wolley that Einstein's prediction had been verified, and has ridiculed my suggestion that their remark had been misunderstood. I had quoted word for word the remarks of Dyson and Wolley to show what they could have meant by the supposed confirmation. The quotations speak for themselves, and establish no more than that the value is nearer Einstein's than Newton's, and also admit that it is certainly much more than Einstein's theoretical value. I also pointed out that these learned astronomers published their book before Royds' results were known, and therefore made no reference at all to the failure of Relativity as regards the spectral shift at the edge. So far, the misfortune has been that there have been only two theories in the field—the Newtonian and the Einstenian, and therefore astronomers have been content to take the minimum possible value for the deflection of light so as to establish that the Newtonian value is wrong and have felt quite satisfied with such a result. Now that I have propounded a third theory, which makes the value larger than had been ever before imagined, future astronomers, may, in making their calculations also see what the maximum possible value of the deflection of light can be. I now hope that observations will no longer be brought down to the minimum possible value on account of existing prejudices in favour of Einstein's theory.

7. Lastly, Prof. Madhav Rao has remarked that my theory has not yet been developed in a comprehensive manner and is a mere tinkering, and until it produces some striking achievements compelling its acceptance it cannot throw overboard such an eminently successful and philosophically satisfactory theory as Relativity.

I claim that I have already covered the entire ground of the General Relativity Theory so far as it can be tested by astronomical observations, and my next paper which is now ready will unify Gravitation and Electricity completely. As to Relativity being " eminently successful and philosophically satisfactory " I may better quote Prof. Madhav Rao's later opinion in his own words " The final conclusions (of Augstine Sesmat) are that for the present it would be as unwise to declare the relativity theory true and definitive as it is to declare it false and indefinite; and that from a philosophical point of view the doctrines must be taken with great care—*conclusions with which one could certainly . . . . agree.*[3]" It may surprise the learned critic when I say that I am not at all anxious that my theory should be accepted quickly. The delay gives me time to develop my theory in annual vacations, which a more competent and whole-time mathematician may be able to accomplish in a shorter time.

S. M. SULAIMAN.

Federal Court,
Delhi,
August 1, 1938.

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[1] *Curr. Sci.*, 1938, **6**, 457.
[2] *Curr. Sci.*, **4**, 1937, **6**, 397.
[3] *Curr. Sci.*, 1938, **6**, 516.

REVIEWS.

Grimsehl's Lehrbuch der Physik, neubearbeitet von Prof. Dr. R. Tomaschek. Zweiter Band/Zweiter Teil: Materie und Äther. 8th Edition, revised and enlarged. (B. G. Teubner, Berlin and Leipzig), 1938. Pp. viii + 456 with 339 Text-figures. Price 14 R. M.

That a new and improved edition of this well-known text-book should appear after a lapse of less than two years is a very good indication of its popularity. A perusal of the book brings the conviction that this popularity is well-deserved. The structure of matter and the interaction between matter and light, or what is usually termed "Modern Physics" is the subject of the volume. The treatment lays stress on the experimental facts and technique, every-day applications being described wherever possible. The arrangement is such as to lead naturally and unambiguously to the theories that explain these facts. The presentation is lucid, and the whole outlook is modern and organically logical. The illustrations give unalloyed delight and add to the clarity of the text. Mathematical detail is only sparingly included so that even a Pass student can follow the subject easily, but the extent of the information is vast enough to suffice even for M.Sc. students, at least on the descriptive side. Wave-mechanical explanations occur side by side with those based on the vector model and the treatment of atomic and molecular spectra is admirable. Besides a general revision in the light of recent knowledge, the new edition includes sections on atomic transmutations and on atmospheric electricity. Some features of the book, however, strike one as very unusual. One of these is the extraordinary amount of space devoted to the exposition of the work and the views of Lenard. Another is the dismissal of the Theory of Relativity with the remark that it is not necessary to go into details regarding this "dogmatic didactic method". General Relativity is not at all mentioned, while all the experiments which are usually supposed to support the Special Theory are here described in detail, but interpreted from the point of view of an "Uräther". Even the mass equivalent of energy is deduced in a special way due to Hasenöhrl and Lenard. Gravitational bending of light and the red-shift of spectral lines are also explained in accordance with Lenard's views. An impartial consideration of the present situation shows that neither the Relativity Theory nor Quantum Mechanics have succeeded in removing the contradiction between the corpuscular and wave aspects of light and matter, or in elucidating the relation between electromagnetism and gravitation. But the methods developed by the Relativity Theory and Quantum Mechanics have proved themselves to be powerful tools, and although they lack "anschaulichkeit", and although the philosophical speculations based on them may not stand the test of time, we feel that further advance will not be divorced from those methods. Accordingly a falling back on special arguments and conceptions to prove results recognized to be first obtained by those methods seems to us to be a backward step. Apart from this feeling, we have nothing but admiration for the book before us, and we heartily recommend it to all students of Physics.

T. S. S.

A Text-Book of Physics. By Spinney. (Macmillan & Co.), 1937. Fifth Edition. Pp. 721. Price 16/-.

A text-book which has been current since 1911, and which has now reached its fifth edition, must clearly have established itself in popular favour, although it is not well known in India. The book is "designed for use as a text in courses offered to university and college students," but only at an elementary level. No more demands are made on the mathematical prowess of the reader than a little algebra and trigonometry, and even the latter is explained in an appendix.

The main subjects occur in the order: Mechanics, Heat, Magnetism and Electricity, Sound, Light. A very wide range of topics is covered, including many modern advances. Indeed in some places the topics change so rapidly that one feels a fuller treatment, even at the expense of the omission of some items, would be preferable. The diagrams are excellent, and many problems are

provided for the student in addition to those solved in the text.

It is good to find proper emphasis laid on vectors; also that angular motion is discussed side by side with linear motion, with a comparison of the corresponding quantities. The gyroscope is introduced but is suffered to remain rather mysterious; one would wish to see a somewhat fuller explanation by the vector model. In optics, a convention of signs is used which makes real rays positive and virtual rays negative. This convention was recommended in the Physical Society's report on the subject a few years ago. It leads to the same equation $1/p + 1/q = 1/f$, for all spherical mirrors and lenses, and is by far the most convenient convention for teaching purposes. The sooner it comes into general use the better. The author adopts this convention, but for some reason on p. 614 he proves a different formula for negative lenses. It would be better to start with the convention and then develop the formula, in all cases, in accordance with it.

The author defines the specific gravity of a body as "the ratio of its density to the density of water at the same temperature". This is certainly not what we measure with a hydrometer, and if the foregoing definition were accepted the specific gravity of a body would change with temperature even when its density remains constant. Surely the accepted term for such a ratio (if ever we require it) is "relative density". The reviewer has urged before that the term "specific gravity" should be used (as it is used by eminent continental physicists) in its proper original sense of specific weight, or weight per unit volume; just as density is specific mass, or mass per unit volume. Similarly specific heat (p. 221) should take its place as a respectable physical quantity, calories per gram per degree, and not as a ratio of two quantities both of which vary.

In the Introduction to Heat, there is some lack of logical connection. The fact that mercury expands uniformly is not a reason for, but a consequence of, its choice as a thermometric substance. In the discussion of radiation, and elsewhere, the ether receives more attention than an extinct concept really deserves. It should be made clearer that the ether is simply a temporary aid to the imagination, like the electric fluids.

It is, perhaps, time that some of the old phraseology should disappear. A case in point is the "ice-pail" experiment, it is after all immaterial what kind of bucket Faraday used. Students sometimes wonder why the ice-pail experiments can be done without ice, especially when there is an ice-calorimeter which requires it. With regard to general style, one's only criticism would be that 'evidently', 'it is evident that', and similar phrases, occur so frequently as to be irritating.

The book is clearly written and is very readable. The printing and production are all that could be desired. In the whole it forms an excellent introduction to the study of Physics, and may be recommended with confidence.

H. J. T.

The Fine Structure of Matter: Part II.—Molecular Polarisation. By C. H. Douglas Clark (Chapman & Hall, Ltd., London), 1938. Pp. 217–457 + lxxii. Price 15*s*.

The Debye theory of polarisation, Fajan's theory of deformation, and the derivation and meaning of dipole moments form the leading themes in this volume. The subject-matter is grouped under five chapters, (i) Dielectric Constants, (ii) The Debye theory of Polarisation, (iii) Molecular Refraction, (iv) Polar Molecules and (v) Molecular fields. In the preface, it is said that "the book is designed to cover the period up to that surveyed by *Science Abstracts* (Physics) of January 1935". But the book bears the date 1938 on its title page, which is very misleading, particularly as no endeavour has been made to bring the volume up to date to the time of publication. Unfortunately for the author some very significant advances in the subject have been made just during this interval, and thus the delayed publication has detracted the book from its legitimate value.

Even otherwise the book is rather disappointing. It purports to be a "Comprehensive treatise". Such a treatise should be more than a mere classified catalouging of all the references say, that appear in the *Science Abstracts*. One expects a critical evaluation, the older works being given their proper place, and the more significant results emphasised. But in this volume under review all available references

are apparently thrown in. The result is that one frequently meets with a series of disjointed statements, such as, to give just one example the last two paragraphs of Section 32 (p. 285, 286). Sometimes even references totally unconnected with the topic are included, such as that in p. 275 to Meyer's paper on the *internal* free rotation in a molecule in a paragraph dealing with the rotation of molecules *as a whole*, their relaxation time, and the anomalous dispersion of dielectric constant.

Mainly on account of the book being too late by four years, the treatment of a number of topics will be found to be very inadequate; thus, *e.g.*, compare the brief single paragraph on "Solvent Influence" on p. 340, with the whole section on the same subject covering 17 pages in the Chemical Society *Annual Reports* of 1937.

It serves no useful purpose to point out various other minor errors in the book, but protest must be made against particularly two features: (1) the extraordinary way of drawing the curves of Mol. Polarisations against f_2 in pages 336–38, etc. with f_2 values along the ordinate, and (ii) the tantalising abbreviations adopted for the names of well-known scientific journals. While it is conceded that there is no universal agreement on these abbreviations yet within a certain margin, the abbreviations adopted are intelligible to the reader. But those used in these series of volumes constitute a challenge to the guessing powers of the reader: try for instance what the following items stand for; J.P., P, Pa, V, R, G and B.B.S. It would have been far better to number the journals arranged in an alphabetical order, and to use these numbers. The reader will then immediately refer to the Index, without first trying and then feeling disappointed that the letters give no clue to the identity of the journal.

The subject-matter of the book covers only 240 pages, while no less than 72 pages are occupied by tables of contents and indexes for the previous and subsequent volumes in this series. Also needlessly thick paper is used for the book, but the printing and binding are up to the good standards of the publishers.

On the whole, the volume under review judged with reference to the subject it deals with, cannot be said to be an useful addition to the list of books on the subject. It may serve however as a fruitful source of information on the varied literature up to 1934.

M. A. G. RAU.

Food for Starving Millions of India. Food Planning for Four Hundred Millions. By Prof. Radhakamal Mukerjee. (Macmillan & Co., Ltd., London), 1938. Pp. xvi + 267. Price 7*s.* 6*d.* net.

Prof. Mukerjee of the Lucknow University is well known for his many thoughtful works on Indian Economics and Sociology. In his latest work, just published, he has systematically surveyed the relations between agriculture, nutrition and population in India. The book merits the serious attention of all interested in the welfare of the country. It will open everybody's eyes to the rapid growth of population and the serious shortage of food supply, and offers a basis of economic planning suitable for adoption by our administrators under the new regime.

The first two chapters deal with 'Pressure of Population' and 'Population Capacity and Food Supply'. From 1871 to 1931 the population of India increased from 206 millions to 353 millions; in 1935 it is estimated to have reached 377 millions and threatens to number 400 millions before long. The author has calculated the total food supply from all sources and even adopting a low standard of requirement, comes to the conclusion that India has now fallen short of food for 48 millions of her average men, provided that agricultural seasons are normal, and droughts and floods do not occur. The agricultural depression has rendered cereal cultivation unremunerative in many areas in small holdings and the tendency of the exports of food crops to diminish does not meet the situation. On the whole, even taking into account the diminution of exports of agricultural produce, the food available per head for consumption has declined. While no less than 12 per cent of the population are completely unprovided for, a considerable proportion of the peasants and workers show inadequacy or unbalance in their food. The author rightly emphasises that a considerable proportion of disease and inefficiency in India has its primary cause in diet deficiency and poverty. The toll of epidemics and the working of other Malthusian checks is referred to in the third chapter.

Food standards and food values, and nutrition levels in different regions and classes are ably treated in the succeeding chapters. Most of the agricultural castes are vegetarian, and milk and milk products and *dal* are the chief sources of proteins. A considerably lower standard of protein requirement, as compared with Western standards, is considered adequate for India, and the traditional vegetarianism of the people is traced to the pressure of poulation on land. The importance of legumes, like peas, beans and pulses is stressed and the introduction of soya-beans is strongly advocated. The lines of improvement of food crops and dietary, and the extension of industrial crops and rural industrialisation are dealt with in two chapters. India's pace of industrialisation is exceedingly tardy and the extension of industries, large, medium-sized or small, is considered the most important means of relieving the present heavy pressure of population on the soil. The author stresses the important rôle of those industries in particular which are distributed nearer the sources of raw materials and offer facilities to the peasants to obtain remunerative prices for the cultivation of raw materials and industrial crops, which may supplement their subsistence cropping.

Prof. Mukerjee also advocates a diminution of hordes of superflous cattle and the rearing of better breeds. Remedies of population pressure are discussed in the thirteenth chapter, and the two final chapters deal with "New Social Attitudes" and "Dysgenic Trends of Population". Here the learned author dwells on the urgency of primary education and such measures of social reform as inter-caste marriage, widow remarriage and the abolition of dowry and bride-purchase. He strongly advocates limiting the family by using methods of birth control.

The book is a mine of useful information on all the various topics included in the wide survey, and the ripe experience and critical faculty of the author contrive to bring out clearly the right and proper methods of food planning. It should furnish abundant food for reflection to the administrator, the economist, the agriculturist, the industrialist, and the social worker alike. The treatment of the subject is throughout scholarly without being pedantic.

B. L. B.

Where Theosophy and Science Meet. A Stimulus to Modern Thought—A Collective Work. Edited by D. D. Kanga. (The Adyar Library Association, Adyar, Madras), 1938. Part I. Pp. 163. Price Rs. 1–14–0 or 3*s*. 6*d*. or 0·85*c*.

Dedicated to H. P. Blavatsky, the first volume or part of the series described to be the outcome of the combined and co-operative effort of a number of members of the Theosophical Society anxious to share the truth or truths seen and realized by them, is devoted to a study of the advancement of life from 'Macrocosm to Microcosm'. The Publisher's Note explains that the entire series made up of monographs written by specialists in science and theosophy will be published in *four* parts at intervals of two or three months. The work is edited by D. D. Kanga who has retired from the Indian Educational Service, and is intended to serve as a stimulus to modern thought.

The first part now published is entitled "From Macrocosm to Microcosm", the second, "From Atom to Man", the third "From Humanity to Divinity" and the fourth "Some Practical Applications". The contributors, Indian, European and American, notwithstanding their obvious differences due to heredity, nationality, *et hoc*, find themselves in agreement regarding the central thesis that Theosophy as understood and interpreted by the monographists and those from whom they have derived their inspiration, is sufficient to solve many of the complicated problems with which modern mankind finds itself confronted to-day.

In the course of the "Introduction," the Editor points out that the "present world crisis is due to the State-chariot being driven by three uncontrolled horses proceeding with unequal speed..." and that "the key to the situation is the study and practice of Theosophy" (p. 11). In the next contribution, Dr. P. K. Roest admits "theosophical formulations are bound to be quite frequently different from those of science on the same subjects," and Fritz Kunz, in his contribution, defines "our position" as "that of a thoroughgoing conceptual monism" (p. 27). G. Polak emphasizing the basic unity of Life feels sure that man's mission will be accomplished only when that state is reached in which

"My throbbing shall be the throbbing of the whole universe" (p. 52). A. F. Khudsen records theosophical corroboration of geological calculation of the age of the earth, or geological corroboration of theosophical computation, if you please. G. N. Drinkwater writes in a similar vein on "Archæology". Marguerite writing on the "Meaning of Symbols", "A Psychological and Philosophical Survey" concludes that the study of symbols "proves that at all times the same essential cosmic truths were taught which form the basis of Theosophy..." (p. 134). Then follows a list of "Scientific Corroborations of Theosophy".

I have summed up at some length the contents of the volume under notice, lest I be accused of having done scant justice to a laudable theme and venture, but, I regret to have to observe that the volume reveals more of partisan enthusiasm, an inordinate desire somehow to find scientific corroboration of theosophical truths rather than any scientific spirit of disciplined investigation. Dr. G. S. Arundale in his *Foreword* has delivered himself of such amusing definitions of Theosophy as must render remarkably remote any chance of a meeting between Science and Theosophy. "Theosophy", he observes, "is the *experience* of the *greatly wise* (italics mine) from time immemorial", and in the next paragraph, he declares, "Thus is Theosophy the eternal mountain of *experienced truth*" (italics mine), "a mountain of Universal Truth", and whatever monists, mystics, metaphysicians and others may say or claim to have realised, an entity *can never be experience and experienced Truth*. Dr. Arundale's definition, or description or whatever it is, stands sentenced to logical demise by its own inherent contradiction. Rhetoric is poor substitute of Reason. Gift of metaphor in the place of metaphysics is gift of stone for bread.

In a journal like *Current Science*, one or two questions should be straightforwardly asked and honestly faced. Modern Science (I use the description collectively) is grounded on quantitative and qualitative methods of exact, precise measurement, experimental control of the phenomena investigated under laboratory discipline, and the explanatory linking of the data collected into laws of universal validity and applicability. Verification under the conditions and discipline of laboratory investigation is the life-breath of modern science. So far as I am aware and so far as the evidence furnished by the book under notice indicates, Theosophy has never attempted a like verification of its data.

Should at all Science and Theosophy meet? I would immediately remove the term "Theosophy" and substitute "Vedanta" or any other similar system of Thought the subject-matter and data of which *ex hypothesi* lie beyond the pale and jurisdiction of experimental verification. The matter may not be allowed to rest here. Who wants the meeting? Is it the scientist or the theosophist? What is the harm cosmic or individual, microcosmic or macrocosmic in Theosophy and Science keeping strictly to their different paths of investigation? Unless indeed these and allied problems are boldly faced and courageously answered there would be little advantage in any artificial unity or *rapprochement* between Science and Theosophy. That is why traditional Eastern wisdom classified the different branches of knowledge according to the nature and characteristics of subject-matter investigated. *Adhyatma Vidya* or philosophy or metaphysics proper, or *Brahma-Vidya* was believed to be a systematic study of certain entities not accessible to the senses *Ati-Indriya*.

Let me lay bare the mental mechanism of those who desire to bring about and arrange for a meeting between Theosophy and Science, and turn on it the search-light of critical attention or examination. Sometimes, even the confirmed atheist, materialist, or the laboratory scientist develops a faint heart, a lily-livered mentality and feels peradventure vague fears of hell-tortures, or sees visions of rosy romance with heavenly houries. Such a scientist may require corroborations from Theosophy or Philosophy.

On the other hand, even a confirmed Theosophist or a philosopher is bound to feel sometimes that he is not standing on the *terra firma* of verified and verifiably or demonstrably certain facts, and that he has been too much above the clouds. Such a theosophist or a philosopher may require corroborations from Science.

I for one am able to see or feel absolutely no need for any meeting between Science and Theosophy. No doubt successful discoveries in the realm of the sciences and their application to the practical concerns of life like industry, means of communication, war-

fare, etc., make it appear as if Science rules. That cannot be helped.

The great religions of the world have all emphasised that the present existence on earth is to be viewed and lived as a preparation for the next, with faith in the grace of God and with realisation of the truth that one's fellowmen are likewise pilgrims proceeding along the Pathway to Reality. *Mind-Control* is the sovereign remedy for practically all the ills that assail civilised nations and communities to-day. *If Theosophy grew scientific, and if Science grew theosophical, neither would do any good to mankind.* Each should pursue its own way and enrich the resources, material and spiritual, of mankind.

R. NAGARAJA SARMA.

British Chemical Industry.*

SIR GILBERT MORGAN and DR. D. D. PRATT have written a most remarkable book. On a screen astonishingly small in relation to the vastness of the subject, they have thrown a moving picture of British chemical industry that rivets attention from cover to cover (dyed with Monastral fast green GS), being historical, modern and vivid. Especially in this country, where an aptitude for chemical industry has been slow to reveal itself, the new treatise will be valued as a foundation for practice and a stimulus to development. In a most attractive literary form, it provides the advanced student with concise but ample information; and should be consulted also by those members of the cultivated public who desire to be cognisant of industrial progress.

The authors have adopted an agreeable arrangement of the chemical arts by grouping them under the naturally occurring raw materials on which they depend. Thus the opening chapter, "Salt", describes alkali manufacture and industrially important chlorine compounds such as bleaching powder and aluminium chloride, while "Sulphur" covers the various forms of sulphuric acid and the related salts of the oxyacids. "Sand, Clay and Limestone" is the chapter-head introducing glass, lime, cement and ceramics, followed by "Industrial Gases" embracing air-liquefaction, the rare gases, synthetic ammonia, nitric acid, carbon dioxide and acetylene. Then follow "Selected Metallurgical Processes" to include nickel, precious metals, sodium, aluminium and magnesium; "Borax and Phosphate" dealing with the manufacture of some new abrasives, phosphorus and superphosphate; "Paints and Pigments" describing the whole range of industrial whites, metal-colours, lakes and monastrals, concluding with sections on the ingredients and manufacture of paints. "Oils, Fats and Waxes" is the caption for vegetable, animal and marine esters, their extraction, refining and hydrogenation, with attention to margarine, soap and glycerine; while "Cellulose" deals with paper and rayon. "Coal" presents the gas, coke and tar industries, low temperature carbonisation and coal-hydrogenation; the remaining chapters comprising petroleum, explosives, dyestuffs with intermediates, plastics with rubber, industrial solvents and fine chemicals, the last-named including anæsthetics, hormones and vitamins.

Along with clarity of exposition, a welcome feature is the skill with which modern practice has been shown to proceed from the more venerable methods. Thus an outstanding impression in the mind of a reader will be the revival, almost a renascence, noticeable in this industry since the War. On an early page the authors replace the old saying that "there was no better barometer to show the state of an industrial nation than the figure representing the consumption of sulphuric acid per head of population," by the more pertinent dictum "there is no finality in chemical industry". Abundant illustrations of this principle are given, among which the following may be mentioned. Until the beginning of the century industrial oxygen was made by Brin's process, now entirely superseded by air-liquefaction and fractionation, leading to scores of millions of cubic feet being used annually for metal-cutting and acetylene-welding, while commercial uses have been found for the by-products, argon, neon, helium, krypton and xenon. The refining

* *British Chemical Industry; Its Rise and Development.* By Sir Gilbert Thomas Morgan and Dr. David Doig Pratt. (Edward Arnold & Co., London), 1938. Pp. xii + 387; plates 32; figures 79; tables 34. Price 21*s*.

of nickel by the Mond (carbonyl) process, one of the outstanding chemical engineering achievements of recent years, now deals with huge deposits of ore derived from Ontario, yielding concentrates rich in platinum and palladium, with minor quantities of rhodium, ruthenium, iridium and gold. Particularly engaging to Indian readers will be the section on aluminium, not only because, arising from the enterprise of Sir Alfred Chatterton, use of aluminium household vessels is widespread, but also for the much canvassed possibility of manufacturing the metal in this country, which possesses the necessary bauxite. Its high electrical conductivity has lately brought aluminium into rivalry with copper as a current-carrier on a very large scale indeed, and its property of yielding an extensive range of alloys with copper, chromium, manganese, nickel, silicon and zinc has greatly augmented the demand in recent years. Even more dramatic has been the commercial emergence of magnesium, now used increasingly in making light alloys required for aircraft, of which magnalium (Mg : Al = 1 : 9) is an example; within twenty years the price per pound has fallen from 25*s.* to 1*s.* 3*d.*

The history of rayon is a wonderful record of perseverance and ingenuity resulting in a new and beautiful fibre being added to the resources of textile manufacturers. In 1891 the Chardonnet process yielded 30,000 pounds of artificial silk through nitrocellulose, and in the following year Cross and Bevan discovered the cellulose xanthate reaction; although application was greatly delayed by technical difficulties, these were finally overcome by Courtaulds, Ltd., on whose patience and skill the vast rayon industry of the world is founded. The 1,000,000,000 pounds manufactured in 1935 comprised viscose yarn (76%), viscose staple fibre (10%) and cellulose acetate yarn (12%), with minor quantities of cuprammonium and nitro-yarns. This imposing production equalled one-third of the total wool-consumption and ten times that of natural silk; the price per pound had fallen to 2*s.* 6*d.* from 12*s.* 6*d.* in 1925. Incidentally, rayon has presented the dye-chemist with new problems, and has had a share in the recent rapid growth of the lacquer-industry while creating a fresh demand for caustic soda, carbon disulphide and acetic acid.

Among so much material of absorbing interest many readers will turn eagerly to the chapter on dyestuffs and intermediates, and will there find a 30-page review of the old, old story which nobody is better qualified to tell than Sir Gilbert Morgan. Some will remember pleasurefully his Hofmann Memorial Lecture (1936) but the present survey is even more vivid, and has the advantage of crowning the early history with a lucid account of quite recent discoveries. No branch of scientific endeavour stages a richer pageant, or one more dramatic in its interplay of success and failure. There pass before us in rapid succession the pioneers, Mansfield, Perkin, Nicholson, Read Holliday, Dan Dawson, Greville Williams and Ivan Levinstein. Then comes the decline of 1865–79 when the Anglo-Germans, Hofmann, Caro, Martius and O. N. Witt returned to the fatherland, recalling the departure of the Roman legions; while Nicholson, Perkin and Greville Williams retired from the struggle. There follows the fall, with increasing predominance of the Rhine, lasting until the War of 1914–18. Thereafter the renascence, effected by the British Dyestuffs Corporation and Sir James Morton, later fortified by the Dyestuffs Group of Imperial Chemical Industries. Table XXX (p. 293) shows 4,000 tons of British dyestuffs to have been manufactured in 1913 (with no vat-colours), and a 1935 output of 26,000 tons including over 4,000 tons of indigo and other vat-colours. Conspicuous among the latter is Caledon jade green, whose romantic history is here narrated as a preface to the Soledons and Ionamines, to be followed by the Duranols and Carbolans, dispersed dyes for acetate rayon.

It might have been expected that the three succeeding chapters would seem an anticlimax, but this is not so, for they deal respectively with plastics and rubber, industrial solvents, and fine chemicals, all of which branches offer surprising novelties of industrial practice. The first describes resins of the bakelite group, then plastics made by combining formaldehyde with casein and with urea (for non-crease Tootal fabrics), the glyptal resins (paralacs) arising from polybasic acids and polyhydric alcohols, and finally the polymerisation resins, exemplified by perspex, the organic glass obtained from methyl methylacrylate. In

1923 the British output of phenol formaldehyde resin approached 500 tons, rising to 15,000 tons in 1936. This remarkable growth has greatly stimulated the manufacture of organic solvents, these being required for applying the resins in the form of lacquer. Not only has the range of solvents been vastly widened, but the quantity in which some are produced has been greatly increased, the most spectacular advance being the synthetic manufacture of methanol. Formerly a by-product of wood distillation, methyl alcohol is now made by catalysis of mixed hydrogen and carbon monoxide, the world-production exceeding 200,000 tons annually.

The very high standard of this work is fully maintained in the final chapter dealing with fine chemicals, among which are mentioned the many new organic reagents for metals depending on the formation of co-ordination compounds; and the spot-tests for phosphorus, tryptophan and the ergot alkaloids. Disinfectants (including the lime-lit prontosil), antiseptics (with dettol), fungicides and insecticides receive due notice, while the pharmaceutical products include anæsthetics, soporifics, antipyretics, arsenicals, sucramine (the ammonium derivative of saccharin, which it excels in sweetness), hormones and vitamins. The section on insulin outlines the manufacture, and relates that the price of this hormone has fallen from 25*s*. to 1*s*. per 100 units of a purity-degree so high that one part will remove 40,000 parts of glucose from the blood stream. Under vitamins will be found a description of the four whose chemical constitution has been elucidated, three of which are now manufactured and sold as adjuvants; here is a noteworthy case of highly refined investigations, conducted in more than one branch of science, being rapidly brought to the service of mankind by enterprising industrialists.

It will now have become evident that this latest work of Sir Gilbert Morgan with Dr. Pratt has quite exceptional interest and value. Table XXXIII (p. 367) shows that the British chemical industry employs over 660,000 persons, and exceeds £400,000,000 in gross output value; but the vital doctrine herein conveyed is the necessity of scientific vigilance and ceaseless research in maintaining this huge superstructure. From that standpoint the book should be read not only by every advanced student and teacher of chemistry, but by all those of non-scientific habit who aspire to guiding public opinion, or to taking part in the government of this country. Here, as in England, there is a tendency not merely to ignore science, but to mistrust it; and even worse, to saddle it with the horrors of modern warfare, disregardful of the fact that these horrors are perpetrated by agents not having the most elementary claim to be classed as men of science. So distorted is the public view of this matter, even among people of cultivated intelligence, that an eminent ecclesiastic recently called for a halt in scientific discovery and invention. In the same confusion of mind an English writer of some (literary) reputation smugly announced, with incredible deficiency of humour, that he had sold his holding (£80) in Imperial Chemical Industries, Ltd., on finding that they manufactured explosives. He did not realise that this is merely one of their countless interests, and that in peacetime these products are manufactured for peaceful purposes alone. It would be more reasonable to refrain from investing in Funding Loan on the ground that the British Government manufactures its explosives solely for war, or preparation for war: or from buying shares in a company making weed-killer, because this is known to have been used for removing inconvenient wives.

If such blind leaders of the blind took the trouble to inform themselves by reading the treatise of Sir Gilbert and his colleague, they would be compelled to recognise that only a minute fraction of the chemical industry is concerned with war-material, and that even this would remain in the harmless category of scientific curiosities or engineering requirements but for the hateful action of non-scientific peace-breakers.

M. O. Forster.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(*University Librarian, Madras*)

Malebranche, Nicolas (1638–1715)

NICOLAS MALEBRANCHE, a famous French metaphysician and mathematician, was born at Paris August 6, 1638. He was the youngest of ten children. His father was secretary to the king. Being sickly he could not attend a public school. After private tuition and a course in theology at the Sorbonne, he took orders in his twenty-third year. His superiors directed him to study church history. But failing to retain facts in his memory, he could not make much progress. His genius remained undeveloped till his twenty-sixth year, when Des Cartes' posthumous *Traite de l'homme* fell into his hands and opened a new world to him. He then abandoned ecclesiastical history and rabbinical lore and plunged with ardour into metaphysical and scientific speculations.

His Contributions to Philosophy

The first and greatest work of Malebranche was the *Racherche de la verite* (1674). It went through many editions and appeared also in Latin and English translations. He wrote several other works which were all collected together in eleven volumes in 1712.

His Contributions to Mathematics

His first piece of research in mathematics related to an explanation of the apparent increase in the diameter of the moon while at the horizon. The *Elements de mathematiques* produced by his student Marquis de Preslet is attributed to Malebranche as the real author by Wallis. Similarly his hand is seen in the *Analyse des infiniment petits*, a work of Marquis da L'Hospital, another of his students. Euler rescued and published several of his results in arithmetic. All his principal mathematical contributions were collected together in print in 1880 by Charles Henry in a work entitled *Recherches sur les manuscripts de Fermat suivies de fragments inedits de Bachet et de Malebranche.*

His Fame and His Outlook

Malebranche was an honorary member of the Academie des Sciences of Paris. In the height of his fame he was overwhelmed with correspondence and visitors, the list including kings and princes as well as many philosophers from other countries. Liebnitz was a frequent visitor. Malebranche was at bottom a solitary thinker rather than one learned in the opinions of others. From the time his genius was stimulated by Des Cartes he scught to enlighten his mind by meditation, rather than to store his memory with the contents of books. An insect, we are told pleased him more than all the books of Greece and Rome. He despised erudition and the kind of philosophy which consists in a collection of the dogmas of various philosophers, since a man may be learned in the history of opinions of others or at least in the verbal expression of these opinions, without himself having learnt to reflect at all. Indifferent to books, he used to meditate in the dark, with the windows shut.

His Dramatic End

Malebranche's end was one of the most dramatic incidents in the history of thought. Berkeley, who had just then published his famous book on immaterialism, sought an interview. He found the aged Father in his cell, cooking a medicine for an inflammation of his lungs. A debate ensued on Berkeley's system. In the heat of dispute, Malebranche raised his voice so high and gave way so freely to the meterial impetuosity of a man of genius and a Frenchman, that he brought on a voilent increase of his disorder which carried him off a few days later, October 13, 1715.

Eimmart, Georg Christoph (1638–1705)

GEORG CHRISTOPH EIMMART, a German Astronomer, was born of a painter at Regensburg, August 22, 1638. Having learnt the art of his father, he studied mathematics at Jena, where he cultivated a passion for astronomy. He settled at Nuremberg and made his astronomical observations for several years, along lines laid down by Regiomontanus. Eimmart was in charge of the Nuremberg Observatory from 1668 till his death.

His Contributions

Eimmart contributed several papers, which were all mostly published in the learned periodicals of Leipzig. One paper entitled *Observation of the eclipse* (of the moon)

November 30th last, made at Nuremberg appeared in V. 16 (1696) of the *Philosophical transactions* of the Royal Society. His contributions occupy 50 folio volumes.

Collaboration with Daughter

Eimmart had the rare good fortune of having an intimate collaborator in his own daughter Maria-Clara Eimmart (1676–1707). Besides helping her father in the compilation of several astronomical tables, Maria-Clara helped him in making 300 drawings of the phases of the moon as seen through the telescope. A further interesting fact is that her husband Henri Muller succeeded Eimmart as the Director of the Observatory at Nuremberg.

Eimmart died at Nuremberg January 5, 1705.

Geddes, James (1763–1838)

JAMES GEDDES, an American Canal Engineer, was born near Carlisle, Pa, July 22, 1763. Till his fortieth year, there was no indication either of engineering interests or engineering talents in him. In 1794, he removed to Syracuse and became one of the pioneers in salt industry. Then he studied law. In 1800 he was made a Justice of the Peace and in 1809 he was appointed Judge of the County Court. He was elected to the Assembly in 1804 and again in 1822. He also served in the Congress from 1813–15.

Stimulation of Engineering Interests

In 1804, when he was a member of the Assembly, the Surveyor-General of New York broached to him the possibility of constructing a canal from the Great Lakes to the Hudson River. This kindled his imagination. He personally investigated the subject and started a vehement propaganda for the undertaking. Moreover, though he had no technical training whatever, he himself ran the first survey in 1808. Then he made similar surveys for two other canals including the Eric canal. After the war of 1812, Geddes was engaged by the Canal Commissioners as one of the four principal engineers. His services were requisitioned throughout the Eastern States and by the Federal Government in exploring and designing several canals.

He was thus in active exploration work till his death in August 19, 1838.

Warington, Robert (1838–1907)

ROBERT WARINGTON, a British agricultural chemist, was born in Spitafields August 22, 1838. He is said to have owed his chemical proclivities to his father, Robert Warington who was one of the influential founders of (British) Chemical Society (1841). Young Robert learned his chemistry at his father's laboratory at the Apothecaries' Hall, where his father was obliged to reside as the Chemical Operator of the Society. Life in the heart of London with no exercise undermined his health.

His Career

Warington was at first an unpaid assistant of Mr. Lawes at the Rothamstead Laboratory (1859) and learned ash analysis. From 1860 to 1862, he worked at South Kensingston as research assistant under Dr. Franklend. Another breakdown in health necessitated a change to country life. Accordingly, Warington spent the next five years as a teacher in the Royal Agricultural College at Cirencister. From 1867–76 he was chemist to Lawes' manure factories at Millwall. Then he turned to Rothamstead once again for a short while and finally settled at Harpenden.

His Contributions

Warington was a profuse writer. 63 papers (including 5 joint ones) were published by him between 1863 and 1900. The first paper bore the title *On the Quantitative determination of the phosphoric acid, by salts of magnesia* and appeared in the *Journal* of the Chemical Society. The last paper, which appeared in the *Proceedings* of the same Society was on *Recent researches in nitrification*. One of the most useful of his writings is a little volume entitled the *Chemistry of the farm* (1881). It is a most widely read book on the subject. It reached its 19th edition during his life-time. It was translated into several foreign languages.

Nitrification

Speaking generally, Warington's work consisted largely of examining and perfecting methods of analysis for use in agricultural chemistry. Most of the methods of analysis elaborated by him have been accepted as standard methods. But his fame rests mostly in his contributions to nitrification. This subject engaged him from 1877 to 1891. His first paper on the subject was entitled *On Nitrification*, and was published (1877) in

Vol. 33 of the *Journal* of the Chemical Society and in Vol. 94 of the *Annales de Chemie*. Warington confirmed the biological nature of nitrification not only in soil but also in ammoniacal solutions inoculated with soil. He showed also that the nitrous organisms were entirely confined to the first nine inches of ordinary soil (1887). He further showed that the nitrification of organic nitrogenous substances (urine, milk) has to be preceded first by their transformation into ammonia. Warington was one of the first to demonstrate that an approximate increase of 350 pounds of nitrogen per acre may be obtained as a result of the growth of inoculated legumes.

In 1906, Warington's health gave way. He had to undergo a serious operation. He never regained his health after this and he passed away, March 20, 1907.

ASTRONOMICAL NOTES.

Planets during September 1938.—Mercury will be a morning star during the month and will be visible low down near the eastern horizon for a short while before sunrise. There will be two conjunctions of the planet with Mars, one on September 4 and the other, a very close one, on September 16. Venus will continue to be a very conspicuous object in the western sky ; it reaches greatest eastern elongation (46°·3) on September 11 and can be seen in our latitudes for nearly three hours after sunset. Mars is slowly moving away from the sun but is still not favourably placed for observation. On September 5, the planet will closely approach the first magnitude star Regulus (α Leonis).

Jupiter will be on the meridian at about 10 p.m. and will be in a convenient position for observation in the early part of the night. So also will be Saturn, which will be a fairly bright object rising about an hour and a half after sunset. It will continue its slow retrograde motion in the constellation Pisces. Uranus is likewise moving slowly in a retrograde direction in the constellation Aries. A conjunction with the Moon takes place on September 14, which will afford an opportunity to observers with simple optical aid to locate the planet. A lunar occultation of some interest that can be seen in this country is that of β' Scorpii (magnitude 2·9) which will occur at about 8 p.m. on the night of September 28.

The Milky Way.—There are a number of interesting regions of the galaxy which can be conveniently observed during the month, immediately after sunset. The great star clouds in Sagittarius, the regions in Aquila and Cygnus which are extraordinarily rich in faint stars, are some of the parts of the Milky Way which merit special attention. Side by side, there are the dark holes and rifts in Ophiuchus and other places, regions apparently devoid of stars, which will repay a careful study. In these regions are found extensive dark clouds which obscure the light of stars situated beyond. These dark nebulæ are comparatively near the sun, the distances varying from a hundred to a thousand persecs.

Zeta Aurigæ.—This is a well-known eclipsing binary system in which the two components eclipse each other in a period of 973 days. During the two recent eclipses, photometric and spectroscopic observations have been obtained in considerable detail by a number of observers. Some interesting facts have been deduced from a preliminary discussion of the results, which indicate that the two components are not of equal dimensions. The diameter of the larger star is about twenty times that of the smaller, which, in turn, is ten times that of the Sun. The larger star is of Spectral type K and has about fifteen times the Sun's mass while the smaller, of type B has eight times the mass of the sun.

T. P. B.

RESEARCH ITEMS.

Binary Quadratic Forms with a Single Class-determinant in each Class.—A. Hall (*Math. Zeit.*, 44 Bd., pp. 85–91) has given certain conditions that the discriminant of a quadratic field (discriminant negative) has to satisfy in order that there is exactly one class of forms in each genus. After Heilbronn proved that the number of classes of quadratic forms with discriminant $\sqrt{-D}$ tends to ∞ with D, S. Chowla showed that the number of classes of quadratic forms in each genus also tends to ∞ with D. Gauss had conjectured that there were only 65 numbers for which the number of classes in each genera is unity. Now Hall has given a number of conditions that D satisfies, in order that it is unity, so that he has contributed a good deal towards the settling, of Gauss's conjecture. Some of the theorems he proves are given below:

(1) If $D = 7$, 15, 12, or 0 (mod 16),
$D \neq 7$, 15,12, 28 or 60,
$D \neq 16n$ or $64n$, $n = 1, 3, 7, 15$
$D \neq 32$ (mod 64), the number of classes in any genera is always greater than unity.

(2) If p^2/D, p, a prime number the same result is true except for a finite number of values of D.

K. V. I.

Remarks on a Sequence.—An interesting property of the sequence $[n\alpha]$ where $[x]$ denotes the highest integer contained in x has recently been noticed by Sprague (*Math. Zeit.*, pp. 20–22). It is obvious that the sequence $[n\alpha]$ contains the sequence $[n \cdot (r\alpha)]$ where r is any integer. Now apart from this trivial case does the sequence $[n\alpha]$ contain another sequence $[n\beta]$ which is not trivial in the previously explained sense? The author has shown by easy calculations [α and β are of course irrational] that $\alpha > 2$ is the criterion for the above property. If α is > 2 and l any integer $> \frac{1}{\alpha - 1}$, then the sequence $\left[n \cdot \frac{\alpha}{l + 1 - l\alpha}\right]$ is a subsequence of the sequence $[n\alpha]$. In terms of irrational numbers the result becomes the following:—If $\frac{\alpha}{\beta}$ is irrational $\alpha > \beta > 0$, then between any multiple of α and any multiple of β there does lie some multiple of $\frac{\alpha \cdot \beta}{\alpha + \beta}$; if the distance between the multiples considered be $< \beta$, then the interval does not contain any multiple of $\frac{\alpha \cdot \beta}{\alpha - \beta}$.

K. V. I.

Sol-Gel Transformations: Sols, Jellies and Curds of Sodium Oleate.—An exceedingly interesting paper on the nature of jellies and curds of sodium oleate has been published by E. Heymann (*Trans. Faraday Soc.*, 1938, 34, 689). Sodium oleate gel is a unique system in that it can exist in two forms, the clear jelly and the opaque curd. By a study of the electric conductivity of these forms Laing and McBain have previously shown that the sol and jelly of sodium oleate which are similar, differ from the curd in structure. Further elucidation of the nature of this difference has been made by the author by a study of the densities of the system sodium oleate-water in its three states and the volume change during the sol-clear jelly-curd transformation.

20·5 per cent. solutions when cooled to 14.8° C. showed the sol-jelly transition, after several hours, followed by the clear jelly-curd transformation which was complete after several days (sometimes 2 to 3 months). The time after the first appearance of the curd nuclei till the curd formation was complete increased with increasing purity of the soap, obviously indicating that small amounts of impurities may act as centres of crystallisation.

There was no change in volume, when the clear jelly was formed from the sol. As soon as the curd formation began the volume decreased and a strong volume contraction was observed with progressive curd formation. The latter observation is significant in view of the fact that in other sol-gel transformations, volume increase owing to decrease in hydration is usually noticed.

By the measurement of densities, it was found that the observed specific volume of the sodium oleate solution was equal to that calculated from its components thereby showing the absence of electrostriction (volume contraction). The salts of lower fatty acids however (*e.g.*, sodium acetate) show very significantly electrostriction. This is obviously due to hydration as a consequence of dissociation and of the dipole moment of the COONa group. The action of this group cannot however differ much with salts of higher fatty acids. Therefore the absence of electrostriction observed is only apparent and attributed to the counteracting process which takes place simultaneously in sodium oleate solution.

The volume change during the process of dissolution of sodium oleate directly in water has been investigated. Sodium oleate swells in water giving an opaque curd which is quickly transformed into a clear jelly. Numerous experiments on soap + water → curd → clear jelly transformations show a decrease of volume in the first stage and an increase in the latter.

This significant observation on the volume decrease in clear jelly-curd transformation or the increase in the reverse process, which cannot be explained on the basis of hydration, is attributed to a change in the micellar arrangement. The liquid micelles in the sol and the clear jelly being structureless and non-crystalline are more loosely built than the crystalline particles of the curd. Therefore there is close packing of the micelles in the latter and sparse disorderly arrangement in the former. This interesting picture of the arrangement of the micelles in the soap curds and jelly explains satisfactorily the anomalous volume change associated with the clear jelly-curd transformation.

K. S. Rao.

Seeds and Germination.—As a result of studies initiated in the Boyce Thompson Institute for Plant Research, Willlam Crocker has defined several classes of seeds in respect of the causes of their delay in germination and has worked out methods for shortening or completely overcoming the delay (*Professional Paper*, April 1936, **1**, No. 29). He finds that the hard coated seeds protect the embryos against the action of moisture and oxygen of the air, and are capable of maintaining their vitality in herbaria and seed cupboards for a century and a half. Filing the hard coat or softening it with hot water or sulphuric acid treatment and then abrading the outer coats are the methods suggested for accelerating germination. Seeds which are impervious to the oxygen supply of the embryos or, are sensitive to light, germinate when planted with little or no soil over them. In the case of seeds of the temperate zone the low temperature stratification ranging from 30° F. to 50 or 55° as a means of after-ripening them for germination, has been found to induce chemical and enzyme changes, necessary to induce the embryos to break the coats. Miss Flemion of this Institute has developed a method by which the viability of even the slowest germinating seeds can be determined. The process consists in removing the embryos from the seed coats and placing on moist filter-paper in Petri-dishes. The live embryos enlarge and in light become green. This method may prove of great value to the seed industry, especially for slow germinating seeds.

A Beetle Pest of Sugarcane.—An account of what threatens to be a serious insect pest of sugarcane in Burma on account of which in extreme cases the cultivation itself has had to be given up in some areas and of a study of various methods of combating the pest is given by C. G. Ghosh (*Ind. J. of Agric. Sci.*, **8**, Part VI). The pest is the black Dynastine beetle *Alissonotum impressicolle* Arr. of which both the larval and the adult forms are responsible for the damage; the larvæ are more serious to ratoon canes than the adults and are capable of killing off entire fields by gnawing away the roots in the course of a few months. The attack is serious only where the ratooning of cane is practised; if the cane crop should be grown only as an annual crop and if it should, in addition, be followed by a non-cereal crop, the beetle can be wholly overlooked. In Burma however, the practice is said to be to ratoon the cane continuously; three ratoons are common and even a fourth and fifth are mentioned. The conditions are, therefore, ideal for the increase of the pest. In addition to the life-history of the pest most of the familiar methods of control were tried, and studied. None of these methods was found to be satisfactory. Among the varieties tried, *viz.*, D. 74, EK 2D, B.H. 10-12, Striped Mauritius, Gilman, POJ 2727 and 2878, F 74, S Mau, Pyinmana Red and Yellow, and Co. 210, 213, 214 and 281, none was found immune; the Co. 213 was however more resistant than the thick canes. Birds, insect and fungal enemies exercised little check. Traps and baits, fumigants like carbon disulphide, potassium cyanide, paradichlorobenzene and several proprietory preparations like Seekay, R.V. 4, etc., were also ineffective. Among cultivation methods, fallowing was the only one which appeared promising, and this and a restriction of the practice of ratooning are recommended for keeping down the pest. Attention is also drawn to experience elsewhere, *viz.*, to the success with the predatory giant toad, *Bufa marinus*, introduced from Barbados to control the allied pest May beetle in Puerto Rico and in the Mauritius, Hawaii and the Philippines; and a trial of this biological method of control by means of the toad enemy is recommended as an important control measure. A. K. Y.

The Lodging of Cereal Grains.—Yet another contribution to the numerous studies on the subject of the lodging of cereal grains is one on the relation of certain plant characters to strength of straw and lodging in winter wheat by I. M. Atkins (*Jour. of Agric. Res.*, **56**, No. 2). The characters studied were breaking strength of straw, height of plant, length of the lower internodes, date of maturity, weight of grain per 100 heads, weight per 100 culms, diameter of culms at base, and stand. The studies relate to a four-year period from 1931 to 1934; the number of varieties varied from 18 in 1931 to 129 in 1934; the studies were made at the Texas-Sub-station, No. 6, Denton, U.S.A., but use was also made of data relating to the same varieties which were grown at other experiment stations. There was considerable variation in the amount of lodging in the different years due apparently to the seasons but taken in conjunction with results on the other experiment stations, the author considers the data sufficiently satisfactory for drawing conclusions. It is shown that lodging is dependent on a number of factors that vary greatly from year to year making it difficult to find any one index that may be considered reliable. Relative breaking strength of straw is shown to be fairly constant from year to year and the relation of this factor to lodging tendency appears to be high enough to justify its use for evaluating new varieties in respect to lodging. A more satisfactory character for such use however is found to be the weight per unit length of culm taken near the base of the plants; the correlation in this case was much higher between lodging and breaking strength of straw. It is suggested that this character may therefore be used as an index of lodging in preference to the breaking strength of straw as it has the additional advantage of easier and quicker measurement and requires no special apparatus. The weight per unit length of culm taken by the author is the weight of a 10 cm. section including the one node between the first upright internode above the crown of the plant and the one immediately above. A. K. Y.

Reaction Kinetics.*

DURING the last twenty years there has been a tremendous progress made in our knowledge of the structure of molecules and a number of refined mathematical methods of analysing these structures by the application of quantum mechanics have been developed. Parallel with the growth of these knowledges, attempts have been made to apply them to an elucidation of the mechanism of reactions between different molecules, and to a study of the problems of chemical reactions in general. There have been however, also keen studies of the mechanisms of reactions on the purely classical considerations of kinetic theories of collision between molecules and the activation energies as calculated from the Arrhenius equation applied to the temperature coefficient of the velocity of reactions. A fair degree of success has been achieved by either of these methods to account for the observed velocities of reactions, but as far as quantitative results go, the accuracy of the two methods is of about the same order, and must at the present time be admitted not to be very high. Indeed, we have virtually arrived at an impasse, and it was mainly in order to " clarify certain aspects of the reaction velocity problem, and further, to review such facts, which either seemed to bear most directly on these aspects, or to represent a body of knowledge suggestive of further developments " that the Faraday Society organised its Sixty-Seventh General Discussion at Manchester during the September of 1937, under the Presidentship of Prof. M. W. Travers, F.R.S. The report of the papers contributed and discussions thereon[1] provides a wealth of information and some very suggestive thoughts on this very engrossing topic of Reaction Kinetics. The twenty-one contributions made in all by the leading workers in the field, are grouped into 3 main sections: Part I—General: On the Theoretical Methods of Treating Activation Energy and Reaction Velocity; Part II—Some Experimental Evidence bearing on the discussions of Part I; Part III—Proton Transfer Reactions and H^+ Reactions.

The basic idea of exploring the mechanism of chemical reactions by plotting the relevant energy surfaces explains in many cases why activation energy is far less than the energy of the disrupted link or links. By making reasonable numerical assumptions regarding magnitudes entering into calculation one can deduce in certain cases the actual experimental values. Following Eyring, the general theory of activation energy calculation can be expressed as follows. A chemical reaction always involves a change in the equilibrium distance between atoms. If N atoms came together in a non-linear configuration to form the activated complex, then three of the 3 N degrees of freedom can be associated with translation of the centre of gravity of the activated complex, and except for an interaction term which is frequently small, three other co-ordinates can be associated with rotation of the system about its centre of gravity. This leaves 3N—6 internal co-ordinates whose specification, together with the electronic state of the system, fixes its potential energy. The potential energy can then be plotted normal to the configurational co-ordinates in a $3n-5$ dimensional space. The resulting surface will show low valleys or basins which correspond to chemical compounds separated by mountain ranges. Through these ranges there are passes and these configurations are the activated complexes. The mathematical formulation and evaluation of the resulting expressions are none too easy. In the first paper of the Symposium, H. Eyring (Princeton) has given a greatly simplified technique of calculating the activation energies of a system of four atoms. From these energy surfaces the next step is to solve the problem of the rate of elementary or unit reactions, one or more of which go to make up a complete reaction. The treatment of this step will differ with the kind of reaction, according to whether there is a change only in chemical constitution, or in the electronic quantum state of the colliding particles as well. Both statistical and thermodynamic methods have been employed to this end. E. Wigner (p. 29) gives a resume of the statistical methods with special emphasis on the basic assumptions involved. The underlying idea in the theory is to calculate the reaction velocity by multiplying the density of points in the transition state by the average velocity of motion in the splitting bond. It must be made clear that the transition state defined here is in no way similar to the Arrhenius conception of an activated complex. The transition state is a configuration of atoms which resists deformation, *i.e.*, the potential energy increases with deformation, in all directions except along the co-ordinate of the direction path. In other words, it forms a saddle region in phase space, with a maximum in the direction of the reaction path only, but it is a minimum in all the other directions. It is in crossing this layer that a reaction takes place. The thermodynamic methods of considering the transition state as in equilibrium with the reactants, have been developed in the several publications of Eyring, Evans, and Polanyi. In two papers on p. 41 and p. 49 of the present volume, specific aspects of this theory are considered by Eyring and by Evans.

In actual practice, the generalised formula for n-molecular processes are not needed, as most measurable processes are of an order not exceeding two, with possibly just some trimolecular processes. Hence, the simple collision theories developed on kinetic considerations have been found to be quite adequate to account for or explain the observed velocities in most cases. According to this theory, reaction takes place provided (a) the relative kinetic energy in the direction of the line between the two centres of masses exceeds a certain critical value E, and

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* Faraday Society Symposium.

[1] *Trans. Farad. Soc.*, 1938, **34**, 1–265, price 12*d*.

(*b*) the two molecules on meeting are suitably oriented relative to each other. The rate is, therefore, written in the form $P.Z.e^{-E/RT}$, where Z is the actual number of encounters between the molecules concerned, and P is the probability that other conditions beyond mere propinquity must be fulfilled. The recent variations in the collision theories and their applications to reactions and ionisations in solution have been given in the papers by E. A. Guggenheim and J. Weiss (p. 57), R. H. Fowler and N. B. Slater (p. 81), E. A. Moelwyn-Hughes (p. 91) and C. N. Hinshelwood (p. 105). In the interesting discussions that followed these papers among the protagonists of the several theories, it was in general agreed that while the new thoeries still suffered from quantitative inadequacies, they possessed very valuable qualitative and conceptual accomplishments. The newer theories also show clearly the sharp dependence of the reaction velocity on both the activated and the initial states, while this dependence is made clear only in the new derivations of the collision theory.

In the second part of the Symposium are reported the results of a number of very varied experimental studies of several reactions both in the gaseous and in condensed phases. Some of these results are helpful in indicating possible further developments of the theories, while others provide tests of the existing ones. Such experimental facts and more of precise data are particularly needed to foster the new theories of chemical kinetics. In the two papers by Wasserman (p. 128) and C. N. Hinshelwood (p. 138), references are made to a large number of data on the values of E and A in the Arrhenius equation $K = A.e^{-E/RT} = P.Z.e^{-E/RT}$ and the separate variations in these factors with changes in the nature of the solvent, reactants, etc. Thus values of E have been measured ranging from 0 up to nearly 100,000 cal., while A has been found to vary over a range of about 12 powers of ten. There is frequently a correlation between the large values of E, and the large values of log A. M. W. Perrin (p. 144) describes the important influences of high hydrostatic pressures on the kinetics of reactions in dilute solution, particularly when large and complex organic molecules are involved. Attempts have also been made frequently to experimentally resolve the value of E the activation energy into separate contributions due to the known physical and chemical properties of the reactants. Thus L. P. Hammet (p. 156) correlates the changes caused by substituent groups in the energy of activation and in the free energy of ionisation, while H. B. Watson (p. 165), traces the relationship between the energies of activation and the dipole moments of the appropriate substituted benzenes. This latter relation indicates that a substantial part of E is provided by the Coloumbic energy of a pair of dipoles, or ion-dipole. The three remaining papers in this section deal with the allied problems of mechanism of substitution reactions, and tautomerism. A primary dissociation of bonds, as a bimolecular process, is often regarded as an essential phase of reaction involving the migration of atoms or groups. A second interpretation often advanced postulates addition as an essential condition for the expulsion of the group replaced, the mechanism being treated sometimes as a termolecular process with a synchronous addition and dissociation. Most of the prototropic tautomerisms involving the " ionisation " of C–H bonds have been decided as involving consecutive bimolecular processes, but the trimolecular mechanism suggested by Lowry appears also to have a certain range of validity. E. D. Hughes (p. 202) has considered the special case of mechanism of substitution in relation to the general problem of Walden inversion.

In the third and last section, four papers are grouped dealing with proton transfer reactions and their bearing on the general problem of reaction kinetics. The phenomena of the general acid and base catalysis was first found and explained by Brönstead and his collaborators. The volocity of these catalised reactions must be determined by a proton transfer mechanism, the substrate molecule by receiving or giving off a proton getting into an unstable state which leads to the reaction examined. Of fundamental importance in this connection is the relation between the catalytic activity and the dissociation constant of the acid or base, given by Brönstead's equation, $K_c = G.K_1^x$, where K_c is the catalytic constant, K_1 the dissociation constant of the acid or base, and G and x are constants for a given substrate at a given temperature, x being less than unity. This relation holds very well for a number of reactions, but has not yet been given a satisfactory theoretical basis. A great deal of attention has also been directed to determine the rate determining steps in these proton transfer mechanisms, the last paper by K. F. Bonhoeffer (p. 252) being devoted to the investigations on the Deuteron transfer in solutions in order to obtain information on the velocity of transfer of hydrogen ions.

This number of the Faraday Society *Transactions* forms a really important monograph on the subject of Reaction Kinetics, a subject, which should ultimately lead to that goal, envisaged by Eyring, whereat "every problem of chemistry can be answered from direct calculation by a sufficiently skilful mathematician."

M. A. Govinda Rau.

SCIENCE NOTES.

Poisonous Gases in Industry.—The Department of Scientific and Industrial Research has issued the second of a series of leaflets describing standard methods for the detection of toxic gases in industry. The present leaflet (published by H. M. Stationery Office, 5/6*d*. net) deals with hydrogen cyanide.

Hydrogen cyanide is manufactured mainly for use in the fumigation of ships and buildings. It is also used to a small extent industrially as a reagent. Further, it is encountered in concentrations which may be dangerous in certain industrial processes—in blast furnace plants, dyestuffs works, gas works and coke ovens and in the industries of gold mining and gilding.

The leaflet points out that a slight symptom of poisoning will be noticed after several hours with a concentration of one part by volume in 50,000 while a concentration of one part in 500 will be fatal. It goes on to say "in addition to the danger of the inhalation of hydrogen cyanide vapour there is a further danger, even to a man equipped with an efficient respirator or other form of breathing apparatus. This danger is the absorption, of hydrogen cyanide through the skin, which is still greater if the skin is wet with sweat, owing to the ready solubility of hydrogen cyanide in water. The faint almond-like smell is easily missed and is quite unsuitable as a method of detection."

The method of test adopted consists of drawing a sample of the suspected atmosphere by means of a hand exhausting pump through a piece of specially-prepared test paper. Full instructions for preparing the test paper and for carrying out the test are given in the leaflet. The various reagents which will react to hydrogen cyanide are reviewed and those recommended are congo-red-silver nitrate and benzidine-copper-acetate which are capable of detecting concentrations down to one part in 100,000. Test papers treated with these reagents will show characteristic stains, specimens of which are included with the leaflet. Both reactions have been made quantitative and have been developed as standard tests for hydrogen cyanide in industry.

* * *

The Story of Vitamin B_1.—A remarkably interesting brochure dealing with the present status of our knowledge on Vitamin B_1 has recently been issued by Messrs. Merck & Co., Manufacturing Chemists, Rahway, N.J. The story of the Vitamin is told in 7 chapters covering 55 pages. The observations of Takaki which led him to the conclusion that beriberi is of dietary origin, the work of Eijkman on the causation and cure of beriberi by employing experimental animals, the demonstration of the multiple nature of the B Vitamin by Goldberger and others, the isolation of the Vitamin B_1 in crystalline form from natural sources by Jansen and Donath, and finally its synthesis by William and Kline, are all briefly dealt with in the first chapter.* The next 40 pages are devoted to a description of the properties, methods of assay, physiological rôle, distribution in foodstuffs, clinical manifestations of Vitamin B_1 deficiency and its therapy and the rôle of Vitamin B_1 in animal nutrition. The characteristic feature of the pamphlet is that the information is precise and up-to-date and is furnished in a direct and eminently readable manner which will appeal both to the research worker and the cultivated lay reader. It is a unique publication which will be of immense value in spreading the knowledge of the chemistry and physiology of the antineuritic vitamin in a manner not fulfilled by scientific journals.

The credit for bringing together all the available information regarding the vitamin goes to Dr. C. B. Addinall. The brochure is a very good example of American commercial promotional literature.

* For a critical account of the B-Vitamins see., *Curr. Sci.*, 1936, **5**, 207; 1937, **5**, 577; 1937, **6**, 490.

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Sugar Industry in India, 1936–37.—Mr. R. C. Srivastava's review published as a supplement to the *Indian Trade Journal* (July 21, 1938) comprises all the statistics, (with the exception of those relating to imports, exports and their value), for the period "November-October". Unusually large crops were obtained in this year from a total planted area of 4·573 million acres which was more than the acreage of the previous year by 10·7 per cent. The total yield of cane was 67,322,000 tons—11 per cent. increase over 1935–36. Consistent with the previous years, 1936–37 also showed an increased adoption of improved varieties of cane.

During 1936–37, 140 factories were in operation out of a total of 150 which had been erected, as against 137 which operated in 1935–36. The total production of sugar direct from cane was 1,128,900 tons exceeding for the first time one million tons, the corresponding figure for the previous year being only 932,100 tons. The all-India recovery for 1936–37 was 9·50, which again showed an improvement over the previous year which had a recovery of only 9·29. There was a decline of 20 per cent. in the sugar produced by the indigenous methods which amounted to 100,000 tons.

Total sugar consumed which is estimated at 12 lakhs of tons for 1936–37 is found to be very near the total produced. Imports of foreign sugar fell very sharply from about Rs. 191 lakhs in 1935–36 to about Rs. 24 lakhs in 1936–37. Imports from Java were also reduced by 90 per cent. of the imports in the previous year while the imports from the United Kingdom practically disappeared.

About Rs. 95·2 lakhs of sugar machinery was imported during 1936–37 of which nearly Rs. 68·5 lakhs were spent on British machinery. The total imports in the previous year were Rs. 65·7 lakhs.

The production of "gur" during 1936–37 has also been on the increase and is estimated at 4,481,000 tons as against 4,101,000 tons in the previous year.

On the 28th February 1938 the Government of India enhanced the excise duty on sugar produced in the British Indian Factories, from annas 10 per cwt. of Khandasari sugar to Re. 1 per cwt. and from Re. 1–4–0 per cwt. of vacuum pan sugar to Rs. 2–0–0 per cwt. The import duty on foreign sugar was raised from Rs. 9–1–0 per cwt. to Rs. 9–5–0 per cwt. The gross excise duty realised on sugar during the year 1936–37 amounted to about Rs. 2·57 crores.

The review concludes with a very interesting survey of the sugar trade of Java and Cuba and a description of the world sugar position. A complete list of sugar factories in India has been appended. G. GUNDU RAO.

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International Conference on Whales and Whaling.—The second International Conference held in June 14–24, 1938, should be deemed a success, if only for securing a prolongation of and achieving the adhesion of additional governments to the agreement regarding restriction of whaling arrived at the first Conference held in 1937 (See *Nature*, 1938, **142**, 101–102). The development of the modern factory ship has led to unrestricted whaling, with the result that some species of whales are on the verge of extinction. Thus a resolution which came up for consideration at the Conference was "The Committee, viewing with alarm the evident decline of the stock of Blue Whales, is of opinion that nothing less than limitation of the total amount of whale oil which may be taken in any whaling season can be effective in preserving the stock of the whales from being reduced to the level at which it can no longer be the object of economic exploitation". It was felt however, that at the present stage it would not be possible to reach general agreement on such a measure. There is evidence that the stock of humpback stands in even greater danger of depletion than that of blue whales. The total number of whales taken in the year 1937–38 season was approximately 44,000 or 10,000 in excess of the previous season. The measures of restriction on whaling on which agreement was reached at the 1937 Conference include the imposition of a minimum size limit for various species and the limitation of Antarctic whaling season to three months and with minor reservations, the prohibition of pelagic whaling north of 40° S.

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The Indian Central Cotton Committee.—The Thirty-seventh meeting of the Indian Central Cotton Committee was held at Bombay on 12–13th July 1938. Sir Bryce Burt, presided.

The chief business of the meeting was the consideration of the progress reports on the various schemes financed by the Committee. In the course of his opening speech, the President said: "I have been struck by the very definite information which several progress reports contain of the definite results which have flowed from our research schemes. Not only have positive scientific results been achieved but these have been extended to cultivator's fields on literally, millions of acres,—thanks to the co-operation of the Provincial Agricultural Departments."

The Committee decided to publish annual accounts of the work done on Cotton in India. This decision will be welcomed, not only by those directly engaged in cotton research but also by those whose interests in cotton are not entirely scientific.

The work done at the Technological Laboratory was reviewed and the purchase of new machinery was provisionally sanctioned including a plant for the control of humidity and temperature at the Laboratory, throughout the year. An interim report on the work done in connection with the utilisation of linters, fuzz and cotton waste, etc., for the manufacture of artificial silk, was considered and approved.

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Indian Central Jute Committee—The fourth *Bulletin* of the Committee for July 1938, includes progress notes of the various schemes of the Committee and trade figures for the production and consumption of jute. The Jute Committee's Laboratory for Agricultural Research at Dacca is nearing completion. Under this scheme both the yield per acre and the quality of jute will be dealt with, including work on methods of retting and preparation. The work will definitely be directed to the improvement of the efficiency of raw jute production. The necessary complement to the Agricultural Research scheme is the work of the Technological Laboratory in Calcutta. One of the main functions of the technological research scheme is the testing of strains of jute produced by the Agricultural Research Staff and samples received from other sources.

* * *

The report of the **Botanical Survey of India** for the year 1936–37 contains 3 sections dealing respectively with the 'Systematic' work, Industrial Section of the Indian Museum and Cinchona and Quinine. The facilities for identification afforded by the Herbarium attached to the Survey, has been increasingly availed of by botanists for identification of collections and for the study of special groups of systematic importance. 108 sheets of Asiatic Palms from Singapore and 41 sheets of various flowering plants from Buitenzorg were added to the Herbarium. An interesting acquisition is a sheet of the aquatic *Aldrovanda Vesiculosa* L. presented by Dr. J. C. Sen Gupta of the Presidency College, Calcutta. The contributions made during the year to the systematic knowledge of Indian plants has been briefly reviewed in this section. To the Industrial Section of the Indian Museum, 341 specimens mostly of fibres, spices, oil seeds and medicinal plants obtained from South India, United Provinces and Bombay Presidency, were added during the year. The industrial section fulfils a very important rôle in the development of industries by supplying information regarding the sources of supply of economic plant products. Authentic specimens are supplied for investigations; the roots of *Aconitum heterophyllus* required for research, by Prof. Lawson of the University College, Southampton, were supplied. Under the third section on Chinchona and Quinine, the closing down of the Burma cinchona plantation has been mentioned. All mature bark obtainable from the plantation was stripped and despatched

to the Mungpoo Factory. The supply of quinine from the Indian Museum reveals the interesting fact that while the sale of quinine sulphate tablets dwindled from 1,222 lbs. to 339 lbs., that of cinchona febrifuge tablets rose from 155 lbs. to 1,442 lbs.

* * *

Industrial Research Council.—At the annual meeting held at Madras, 8-9 August, the Council considered the report of the Prizes Committee on the papers received and selected six papers for the award of prizes as follows:—

Rs. 500—'Catalytic hydrogenation of oils'—Mr. S. K. Kulkarni Jatkar, Mr. V. T. Athawale and Mr. J. G. Kane, Indian Institute of Science, Bangalore.

Rs. 250—'Recovery of titanium oxide as a by-product in the manufacture of alumina-ferric from bauxite'—Mr. Sudir Chandra Chakrovarty, M.Sc., Calcutta.

Rs. 250—'Conversion of the standard poly-phase squirrel-cage motor into an internally compensated poly-phase squirrel-cage motor'—Prof. J. J. Rudra, College of Engineering, Saidapet, Madras.

Rs. 150—'Control Instruments for the timber industry. Electric moisture meter for wood'—Mr. D. Narayanamurti, Forest Research Institute, Dehra Dun.

Rs. 150—'Ammonium alum as a catalyst for the production of ether'—Mr. S. K. Kulkarni Jatkar and Mr. T. Subramanya, Indian Institute of Science, Bangalore.

Rs. 150—'Development of metallic lustre (Bronze) on glazed articles made of common Indian plastic clay'—Mr. Sasadhar Roy, M.Sc., Industrial Research Laboratory, Department of Industries, Bengal, Calcutta.

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Nanga Parbat Expedition.—Dr. Paul Bauer, leader of the Nanga Parbat Expedition, returned with all the members, the attempt having been abandoned after reaching Camp 5 " owing to snow and wind ". (see *Curr. Sci.*, 1938, **6**, 581).

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Report of the Food Investigation Board (London), 1936.—This report gives a short summary of seventy-eight investigations carried out by the Food Investigation Staff mainly at the Low Temperature Research Station, Cambridge. The work is mostly concerned with the technical problems concerned in the preservation of foods not usually consumed in India. There is very little of general scientific interest.

R. PASSMORE.

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How the Santals Live.—At the ordinary meeting of the *Royal Asiatic Society of Bengal* held at Calcutta on Monday, the 1st August, Mr. P. O. Bodding read a paper on the every-day life of the santals. The author who has spent a life-time in the midst of the santals possesses an intimate knowledge of their life. The paper gives an account of the village organization, agricultural activities, social habits, food and clothing.

* * *

National Academy of Sciences.—Sir Shah Muhammad Sulaiman, Judge of the Federal Court, has been unanimously elected President of the National Academy of Sciences, India, at a meeting of the Council and the General Body of the Academy held on Sunday July 17.

The Council of the Academy also decided to award the Education Minister's Gold Medal for the year 1938 to the author of the best paper published in the *Proceedings* of the Academy in the subjects Botany, Zoology and Agriculture.

* * *

Indian Botanical Society.—Dr. Yâjñavalkya Bhâradwâja, M.Sc., Ph.D. (London), F.L.S., F.N.I., Professor of Botany and Head of the Department of Botany, Benares Hindu University, has been elected the Secretary of the Indian Botanical Society in place of Dr. E. K. Janaki Ammal who has resigned.

* * *

We are happy to congratulate **Dr. M. S. Krishnan** on his appointment as Assistant Director of the Geological Survey of India. Dr. Krishnan who has a distinguished record of service as an officer of the Geological Survey, has been called upon, on several occasions, to fulfil responsible offices. He was a member of the Indian Coal Mining Committee of 1937, and President of the Geological Section of the Indian Science Congress, 1936. He has the distinction of being the first Indian to be appointed to this post.

* * *

Dr. Arthur Geddes.—The well-known Geographer from the University of Edinburgh and son of the late Sir Patrick Geddes, is just now on a visit to India making a Geographical Reconnaissance of the Country. He is greatly interested in the ' human ' side of regional geography, and will stay in India for about six months. Seeing that Man has always shown a tendency to live in social groups, a study of the organisation, maintenance and development of this group life will naturally be of great interest, especially when correlated with physical and geographical changes in environment. It is from this point of view that Dr. Geddes proposes to study the regional geography of India, and he has already done some work of this kind in Bengal during his brief visit to this country about ten years back. He is convinced that opportunities for such studies in India are immense, and has now come back to make a longer stay with a view to see more of the country in detail and gather first-hand knowledge in regard to the problems in which he is interested. On the conclusion of this study tour, Dr. Geddes proposes to publish an elaborate monograph dealing with the results of his researches, and we have no doubt that this publication will be a valuable and pioneer contribution in this new and fascinating field of geographical studies in India.

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Medical Congress.—Colonel I. Froilano de Mello, by invitation of H. E. the Minister of Colonies from Portugal, will attend the following Congresses:—

1. Thirty-second **South African Medical Congress** which will be held in Lourenco Marques (Delagoa Bay) under the presidentship of Dr.

Vasco Palmeriim, Director of Medical Service in Mozambique, from 8th to 14th September. The work of this Congress is divided into five main sections: Medicine, Surgery, Obstetrics, and Gynæcology, Public Health and special subjects comprising Ophthalmology, Otology and Laryngology, Dermatology, Venereology, Radiology and Physiotherapy, Anæsthetics, Pediatrics, Psychiatry and Neurology. Many distinguished professors of Johanessburg, such as Prof. W. H. Craid, Dr. W. Russell, Groeber, C. Smith and some of Portugal (Prof. Gentil, Costa Sacadura, J. Porto, Moraes Frias) will attend the Congress. In plenary sessions the following important problems will be discussed:—

"Bronchopulmonary non-tuberculous chronic suppurations from the medical, surgical and radiological points of view.

"Malaria, to which Prof. F. de Mello contributes two papers on experimental treatment of malarial splenomegaly by the method of Ascoli, and treatment and prophylaxis of malaria through chimiotherapy.

Col. de Mello will also read a paper on *Levuroses* in human pathology.

Third International Congress of Tropical Medicine and Malaria to be held in Amsterdam from 24th September to 1st October, under the presidentship of Dr. G. Gryns, the section of Malaria being presided over by Prof. N. H. Swellengrebel. The items of this Congress comprise: (1) Deficiency diseases; (2) Filariasis; (3) Leptosperosis; (4) Yellow Fever; (5) Antiplague Vaccination; (6) Amebiasis; (7) Malaria; (8) Rabies; (9) Rickttsiosis; (10) Extermination of Glossinæ.

* * *

Sir Arthur Olver, until recently, Animal-Husbandry Expert, Imperial Council of Agricultural Research, India, has been appointed Principal of the Royal (Dick) Veterinary College, Edinburgh, in succession to Principal Bradley.

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University of Allahabad.—Pandit Amarnath Jha, Head of the English Department, assumed charge of the Vice-Chancellorship on the 8th August, in place of Mr. Iqbal Narain Gurtu, who has gone on leave.

* * *

Travancore University.—A grant of Rs. 8 lakhs was made by the Travancore Assembly for the newly started Travancore University. A sum of Rs. 2 lakhs will be spent for the University buildings and 6 lakhs for current expenditure in the various Colleges and University Institutions such as the Library and Museum.

* * *

University of Calcutta.—According to a *United Press* message the Syndicate of the Calcutta University has decided to start a degree course in Architecture—Bachelor of Architecture—which will be open to any undergraduate of the University.

The course will cover a period of four years, two years for the Intermediate Examination, and two for the Bachelor degree examination. Passed B.Sc. students will be exempted from the first year class of the Intermediate course, but they will have to qualify themselves in the drawings section prescribed for the first year of the Intermediate Examination.

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Benares Hindu University.—According to an *Associated Press* message, at the instance of the U.P. Government, the Benares Hindu University has deputed two experts to Almora and Mirzapur for a survey of mineral possibilities in these hilly tracts. It is stated that copper and iron ores exist in Almora district, but have remained unexplored so far, due mainly to communication and transport difficulties. The government have sanctioned six thousand rupees for the purpose.

* * *

Madras University.—The Degree of Master of Science has been conferred on (1) Mr. N. Subrahmanya Wariyar, in consideration of thesis entitled "A Chemical Examination of Some of the Travancore Plant Products" and (2) K. Lakshmana Rao, in consideration of thesis entitled "Deflection in Reinforced Concrete Structures".

* * *

Dr. B. V. Raghavendra Rao has been awarded the Degree of Doctor of Science by the University of Madras for his thesis entitled "Investigations in Light Scattering and Spectroscopy," which he carried out as a research student of Sir Venkataraman, in the Physics Laboratory at the Indian Institute of Science. We have pleasure in congratulating the young man who, we hope, will be able to carry forward the brilliant researches he has initiated. His work forms an important contribution to our knowledge of light scattering in liquids and the nature of the liquid state. The importance of the results obtained by the author has received handsome recognition from subsequent workers in authoritative journals and reference books, and the British Delegation of Physicists, who had opportunities of examining the work of Dr. Raghavendra Rao, have, in a contribution published in *Nature* (Vol. 141, No. 3562, February 5, 1938) on Scientific Research in India observed that "at the Tata Institute at Bangalore the experiments in the Physics Section on backward internal scattering of light in liquids show a combination of high experimental skill and first-class apparatus."

* * *

Academia de Sciences e Artes, Av. Marechal Floriano, 5, Rio de Janeiro, Brazil.*

Our attention has been recently drawn by Mr. M. T. Chobe, Indian Institute of Science, Bangalore, to a series of articles that appeared in the *Industrial and Engineering Chemistry* (News Edition), exposing the *bona fides* of the Academia de Sciences e Artes. As we have no doubt, that the facts concerning this Academy will interest our readers we are quoting below the relevant portions from Mr. Chobe's letter.

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* Since writing the above, Prof. B. Dasannacharya of the Benares Hindu University has also drawn our attention to the articles appearing in the *Industrial and Engineering Chemistry* (News Edition) regarding the Academy.

" In an editorial of the *Ind. and Eng. Chem.* (News Edn., 1936, **14**, 492) it is stated " We have made careful inquiry through reliable and established channels and learn, . . . that this academy is not a reliable institution.. . . .we expose this swindle in the interest of our readers."

Later, a prominent chemist from Brazil, C. E. Nabuco de Araujo, Jr. writes (*Ind. and Eng. Chem.*, News Edn., 1937, **15**, 132) "this academy is not a reliable institution" and " the Ministry of Labour refused to register the diplomas of chemists granted by that academy, since it is not recognized as an official school. . . . "

Further warning by the Editor of the *Ind. and Eng. Chem.* (News Edn., 1937, **15**, 189): "This is not a reputable institution, and money should not be wasted in securing its proffered degrees."

In spite of these notices, chemists in U.S.A. were still approached. So the Editor reproduced a photograph of the diploma along with the correspondence pertaining to it, as received by the members of A.C.S. (*Ind. and Eng. Chem.*, News Edn., 1937, **15**, 452).

More recently C. E. Nabuco de Araujo, Jr., Caixa, Postal 970, Rio de Janeiro, published a note in the same *Journal* (1938, **16**, 79) wherein he writes: " Because of this exposure the Brazilian Chemical Society, of which I am honorary president, presented a petition to the government requesting that the ' Academia ' be closed in accordance with the law regulating the exercise of the chemical profession in Brazil.. . . . . In order to avoid a repetition of such practices, it will be of great help to the Brazilian Chemical Society, if American chemists will call its attention to any future solicitations of like character."

* * *

Professor B. Sahni, F.R.S., Head of the Department of Botany, University of Lucknow, has returned to India after his recent visit to Vienna. We have pleasure in welcoming him.

* * *

We have pleasure in announcing that Dr. Nazir Ahmad, O.B.E., Ph.D., F.Inst.P., Director, Cotton Laboratory, Professor M. R. Siddiqui, M.A., Ph.D., F.N.I., Osmania University, and Dr. Khwaja Habib Hasan, L.Ag., M.Sc., Ph.D., Director, Government Industrial Laboratory, Hyderabad, Deccan, have accepted our invitation to join the Board of Editorial Co-operation, and we welcome this accession of strength to the large body of scientists forming the Board.

Announcement.

The Eleventh **International Congress of Chemists**, will be held in London, in 1941, about the time of the celebrations of the Centenary of the Chemical Society.

The Seventh International Management Congress.—The Seventh International Management Congress will be held at the United States Chamber of Commerce, Washington, from September 19th to 23rd. The objective of the Congress is a free discussion, from a world-wide view-point, of the problems and achievements of management in agriculture, industry and the home. An attempt is made:

(1) to provide a forum for the interchange of management experience in order to increase the efficiency of production and consumption of all forms of goods and services;

(2) to appraise the present situation and probable future course of management in its broader, social and economic aspects;

(3) to provide an authoritative and public reminder to management itself and to the world it serves, of the fact that the only type of management worthy of the name is that which contributes to the welfare of mankind.

Francis Amory Septennial Prize.—In compliance with the requirements of a gift under the will of the late Francis Amory of Beverly, Massachusetts, the American Academy of Arts and Sciences, announces the offer of a septennial prize for outstanding work with reference to the alleviation or cure of diseases affecting the human genital organs, to be known as the "Francis Amory Septennial Prize". The gift provides a fund from which the income may be awarded for conspicuously meritorious contributions to the field of knowledge " during the said septennial period next preceding any award thereof, through experiment, study or otherwise. . .in the diseases of the human sexual generative organs in general". The prize may be awarded to any individual or individuals for work of " extraordinary or exceptional merit " in this field.

In case there is work of a quality to warrant it, the first award will be made in 1940. The total amount of the award will exceed ten thousand dollars, and may be given in one or more awards. It rests solely within the discretion of the Academy whether an award shall be made at the end of any given seven-year period, and also whether on any occasion the prize shall be awarded to more than a single individual.

While there will be no formal nominations, and no formal essays or treatises will be required, the committee invites suggestions, which should be made to the Amory Fund Committee, care of the American Academy of Arts and Sciences, 28, Newbury Street, Boston, Massachusetts, U.S.A.

Seventh International Congress of Genetics.—The Seventh International Congress of Genetics will meet in Edinburgh in 1939, probably August 23 to 30, under the Presidency of Dr. N. I. Vavilov, Director of the Institute of Plant Industry, Leningrad, U.S.S.R. Detailed plans are not yet worked out but it is planned that at the plenary sessions, invited speakers will discuss selected topics such as Animal and Plant Breeding in the light of Genetics, Certain Aspects of the Gene and Chromosome Theory, Polyploidy and Hybridisation in plants, Human Genetics, Properties of the Chromosome. There will probably be sectional meetings dealing with Animal Breeding, Plant Breeding, Physiological Genetics, Human Genetics, Gene and Chromosome Theory and so forth. There will be the usual run of demonstrations, public lectures, official receptions and probably a pre-congress tour. For information, those interested may communicate with

F. A. E. Crew, Esq., Institute of Animal Genetics, West Manis Road, Edingurgh, 9, Scotland.

Epidemic Dropsy.—In a letter addressed to the Editor, *Indian Medical Gazette* (1938, 34, No. 2), Lt.-Col. R. N. Chopra, Director, School of Tropical Medicine, Calcutta, and Dr. R. B. Lal, Director, All-India School of Hygiene and Public Health, Calcutta, have issued an appeal to the Medical Profession for co-operation in the study of the causative principles of Epidemic Dropsy. They write that " India is already ravaged by such diseases as malaria, leprosy and tuberculosis, the loss of life and disablement are appalling. Notwithstanding these scourges, another disease has made its appearance during the last sixty years. It is popularly known as ' beri-beri ', but as it is quite distinct from diseases caused by a vitamin deficiency, it has been labelled as ' epidemic dropsy '. Serious epidemics are fortunately rare, but it has made a more or less permanent home in Bengal, and a large number of people suffer every year. They do get over it temporarily, but a damaged heart is left as a permanent legacy, in most of the cases. Only those people who consume mustard oil are attacked; Sikhs, Marwaris and Europeans on European diet do not suffer at all. All samples of mustard oil are not harmful, but evidences have now accumulated which makes us feel that certain samples of mustard oil have got a poison responsible for the symptoms. It has not been found possible to isolate this poison so far. It is extremely difficult to get those samples of oil which produce swelling of the legs and damage to the heart. We sincerely appeal to the medical profession to help us in the investigation of the causative principles of the disease by putting us in touch with samples of oil which they think are responsible for the causation of the disease. Any information regarding the source of supply of the oil, *e.g.*, the oil mill, etc., will be appreciated. We have no doubt that if the public help us the cause of ' epidemic dropsy ' would be definitely ascertained and the disease totally eradicated."

Sir P. C. Ray 70th Birthday Commemoration Medal.—Applications are invited from Research Chemists *below 30 years of age* for the above competition. Only independent papers, which have been published in the *Journal of the Indian Chemical Society* during 1937, will be considered.

Applications together with 3 copies of reprints of each paper are to reach the Hon. Secretary, Indian Chemical Society, Post Box 10857, Calcutta, not later than *30th September 1938*.

Mysore University.—The Sri Krishnarajendra Silver Jubilee Lecture for 1938 will be given on Saturday, 27th August, at Bangalore, by Rao Bahadur Dr. A. Lakshmanaswami Mudaliar, M.D., F.C.O.G., a leading authority on Gynæcology and Obstetrics. The subject of his address is "The Discoveries of Medical Science and their Effect on Human Welfare".

We acknowledge with thanks, receipt of the following :—

" Agricultural Gazette of New South Wales," Vol. 49, No. 7.

" Journal of Agricultural Research," Vol. 56, Nos. 8–12.

" Indian Journal of Agricultural Science," Vol. 8, No. 3.

" Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 6.

" The Phillippine Agriculturist," Vol. 28, No. 2.

" Allahabad Farmer," Vol. 12, No. 3.

" Journal of the Royal Society of Arts," Vol. 86, Nos. 4466–68.

" Biochemical Journal," Vol. 32, Nos. 5–3.

" Biological Reviews," Vol. 13, No. 3.

" Communications from the Boyce Thomson Institute," Vol. 9, No. 4.

" Chemical Age," Vol. 38, No. 991 ; and Vol. 39, Nos. 992–94.

" Journal of Chemical Physics," Vol. 6, No. 7.

" Journal of the Indian Chemical Society," Vol. 15, No. 5.

" Berichte der Deutschen Chemischen Gesselschaft," Vol. 71, No. 7.

" Journal de chemie physique," Vol. 35, No. 5.

" Experiment Station Record," Vol. 78, No. 6.

" Transactions of the Faraday Society," Vol. 34, No. 207.

" Indian Forest Records," Vol. 3, No. 10.

" Forschungen und Fortschritte," Vol. 14, Nos. 20 and 21.

" Genetics," Vol. 23, No. 4.

" Bulletin of the Health Organization (League of Nations)," Vol. 7, No. 2.

" Scripta Mathematica," Vol. 5, No. 2.

" Bulletin of the American Meteorological Society," Vol. 19, No. 5.

" Calcutta Medical Journal," Vol. 34, No. 2.

" Review of Applied Mycology," Vol. 17, No. 6, and Index to Vol. 16.

" Nature," Vol. 141, Nos. 3582–85.

" Indian Journal of Physics," Vol. 12, Part 3.

" Research and Progress," Vol. 4, No. 4.

" Journal of Research (National Bureau of Standards)," Vol. 20, Nos. 2–4.

" Ceylon Journal of Science," Vol. 4, Part 4, Section D.

" Sky," Vol. 2, No. 9.

" Lingnan Science Journal," Vol. 17, Nos. 2 and 3.

" Science Forum," Vol. 3, No. 1.

" Science Progress," Vol. 32, No. 129.

" The Indian Trade Journal," Vol. 130, Nos. 1673–76.

" Journal of the Annamalai University," Vol. 7, No. 3.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences.

July 1938. SECTION A.—NAZIR AHMAD CHOWDHRY AND R. D. DESAI: *Heterocyclic Compounds. Part VII. Coumarins from Resacetophenone and Cyclic-β-ketonic Esters.*—The condensations have been carried out in the presence of phosphorus oxychloride, with the formation of 7-hydroxy-6-acetyl derivatives of cyclohexano- and octalino-coumarins. M. A. GOVINDA RAU: *Diffraction of Light by Superposed Ultrasonic Waves.*—Pictures are reproduced showing the presence of combinational lines as well as the characteristic manner in which their number and intensities depend upon the intensities of the original spectral orders. P. V. SUKHATME: *An Application of the Bi-partitional Function Hg (P, Q) in the Enumeration of different Samples from Finite Population.* NAZIR AHMAD CHOWDHRY AND R. D. DESAI: *Heterocyclic Compounds. Part VIII. Coumarins from Alkylcyclohexanone-2-carboxylates and* Trans-*β-decalone-3-carboxylate.* K. S. K. IYENGAR: *On Linear Transformations of Bounded Sequences—II.* P. NILAKANTAN: *Magnetic Anisotropy and Pleochroism of Biotite Mica.*—The biotites are highly anisotropic, the anisotropy and pleochroism increasing more than linearly with the ferrous iron content. The pleochroism of biotite is discussed in the light of Saha's view that absorption of light in inorganic salts of elements of the transition series is due to transitions involving the reversal of the spin vector of one of the third electrons of the Catolin.

July 1938. SECTION B.—P. N. MEHRA: *A Study of the Chromosome Number in Some Indian Members of the Family* Codoniaceæ.—The diploid chromosome number in each of the three Indian species *Fossombronia himalayensis* Kash., *Petalophyllum indicum* Kash., and *Sewardiella tuberifera* Kash. is 18, but the morphology of tne chromosomes in each species is different from the other The basic chromosome number in the family *Codoniaceæ* appears to be 9. P. N. MEHRA: *Abnormal Sporocarps in* Marsilea minuta *Linn.*—The megasporangia of the normal type are absolutely lacking in the sporocarp. In the sporangia there are found 16 fairly large irregular angled spores which apparently seem to be non-functional. In others there are observed 16 such large spores and besides a few other comparatively similar spore-like bodies with thick walls. Another interesting fact is that a plant bears either all the normal type of sporocarps or all the abnormal sporocarps. DONTCHO KOSTOFF: *Heterochromatin, Somatic "Crossing-Over" and the Interchange Hypothesis between Non-Homologous Chromosomes.*—An attempt to correlate a series of phenomena, connected with chromosome interchanges and crossing-over. A number of existing theories and hypotheses have been considered in the light of new researches and for a series of phenomenon new interpretations are given which should be considered at present as working hypothesis. S. B. KAUSIK: *Studies in the Proteaceæ.* S. M. SIDDIQUI: *Studies on the Caudal Autotomy and Regeneration in* Mabuya dissimilis *Hallowell.*

Indian Association for the Cultivation of Science. (*Proceedings.*)

May 1938.—W. BOTHE: *Hard Cosmic Ray Showers.* S. R. DAS: *A Study of Sulphur Allotropes by the X-Ray Diffraction Method. Part I.* K. BANERJEE AND ABDUL HAQUE: *Space Group of Creatinine.* H. MUKHERJEE: *Determination of the Frequency of the Oscillator with a Condenser.* S. SHARAN: *Magneto Resistance Change of Ferromagnetics in Alternating Magnetic Field.* R. R. BAJPAI AND B. D. PANT: *A Study of the F. Region of the Ionosphere.*

12f0-38.—Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent, and Published by H. N. Sastri, M.Sc A.I.C., A.I.I.Sc. for the "Current Science" Board of Editors, Indian Institute of Science, Hebbal Post, Bangalore

VIRGIN